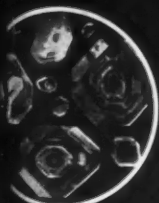
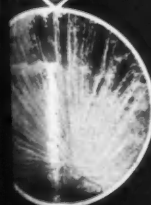


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Editorial:

Tracer Carbon
Inside Front Cover

25¢

Tracer Carbon

► A VERY FEW years ago people would look at a person queerly who claimed that he could take an old bone, or a bit of charcoal or a stick and tell how old it is. Yet such is the modern "magic" of isotope chemistry that a few ounces of organic material is all that is needed to determine its age within a few hundred years, provided it is less than about 25,000 years old.

This is a by-product of the atomic age, although we know now that the universe beat the scientists to manufacture of radioactive carbon, first discovered through man-caused atomic bombardment.

As long as there have been cosmic rays, which must have been very close to the beginning of earthly things, small amounts of radiocarbon, atomic weight 14, were formed whenever they smashed into the nitrogen of the atmosphere. This radiocarbon is the substance of an atomic calendar which can be read with a Geiger-type counter.

Thus chemistry brings a revolution to archaeology, upsetting ideas about the antiquity of some prehistoric cultures and raising other dead to new ancientness.

The geologist, too, has a new way of dating the very recent layers of the earth plowed by the last great ice age. A bit of wood is almost-as positive now as a good run of tree rings.

Radio carbon, made in atomic reactors in relatively immense quantities, is being used to trace out some of the other secrets of living and non-living things—how drugs act, how the green leaf works, how friction operates, and a thousand other such intriguing tasks.

Care is being taken not to spread this artificially-made radiocarbon too widely, but perhaps we should make a warning entry into our history for those who follow us a few thousand years here on earth.

The exploration of the natural radioactivities around us is far from complete. Perhaps enough of even longer-lived substances will be found that will allow the dating of even other materials, intermediate between the lead and the helium contents measuring the age of the earth and the newly found wonders of carbon that explodes.

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► DATED BY RADIOCARBON, these tragic bones of a child and an adult are about 5000 years old. Analysis of C14 in the charcoal of the ancient hearth nearby (arrow) in this excavation by Dr. W. A. Ritchie, New York state archaeologist, shows that pre-Indian cultures in Eastern United States are 3000 years older than previously supposed.

Chemical Calendar for Archaeology

► A NEW KIND of calendar, read chemically from exploding atoms within all matter that once was living, gives modern scientists a way to determine time in our prehistory through the last 25,000 years.

Giving accurate dates to the remains of our ancestors of recent millennia and real time determinations to the younger layers of the earth, this new radioactive timing method is an indirect by-product of the atomic bomb.

The "ticking" of the radioactive "clock" is caused by the exploding of radioactive carbon atoms, a few of which are mixed in with carbon dioxide of the air and water.

This unstable kind of carbon, atomic weight 14 instead of the normal 12, is manufactured constantly in the upper atmosphere of the earth by cosmic rays from outer space smashing into nitrogen atoms and transmuting them. This radioactive carbon has a relatively long life. Half of the

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atoms formed at any one time will have exploded in 5,568 years, with a possible error of 30 years; the radioactivity can be traced about 25,000 years. When the exploding carbon comes down to earth, it mingles with and "tags" living things, ourselves, our food, trees, plants and the many other organic things that we use or ancient peoples used.

Only in 1947 was it realized that radioactive carbon is created in this way. Dr. Willard F. Libby, University of Chicago chemist, and Dr. A. V. Grosse of the Houdry Process Corporation, in a group research showed that organic material of recent origin (they used methane gas from sewage) contains radioactive carbon, while much older material, such as petroleum, does not.

From this experiment, seemingly so remote from ancient times, has come this new time-measuring technique that promises to give archaeology and geology new standards.

When the application of radioactive carbon to dating prehistory was realized, scientists in various fields cooperated to pick out 300 specimens from museums and treasured collections that would give the largest amount of information when tested. Over half of these have been analysed for radioactive carbon.

Several ounces of material preferably and a minimum of one ounce are needed for a test. Refined methods of chemical separation are used. Then the carbon 14 separated has its age taken by putting it for 48 hours in a Geiger-type counter, which is 50 times more sensitive than the usual sort. Ages can be determined to with-

in several hundred years by this method.

The first "atomic calendar" for man's prehistory has been begun by the team of Drs. Willard F. Libby and James R. Arnold in the University of Chicago's Institute of Nuclear Studies. Other laboratories, including one at the University of Michigan, are planning similar set-ups for making the "atomic calendar" tests.

The new dates for human prehistory of the Americas in general make human occupation of the western hemisphere somewhat more recent than most of the previous estimates.

The last great ice age was over about 12,000 years ago whereas geologists have been setting the time as something like 20,000 years. But the glacial epoch in Europe was at the same time as the American final retreat of the ice cap, judging by the samples from Wisconsin compared with those from Ireland, England and Germany.

After the ice retreated then man came into America. The new radioactive carbon dates do not change the general idea that America was populated from Asia across the Bering Strait, but the new times may mean that the migration was somewhat more recent than supposed.

Man's first proved existence in North America was 10,000 years ago, shortly after the glaciers receded. The first known Americans were evidently in Oregon and Nevada.

A great store of some 300 pairs of woven rope sandals, found in a cave in eastern Oregon, have been definitely dated as the oldest artifacts so far measured in the Americas. They are

approximately 9,000 years old. And the cave was covered by a volcanic eruption.

Farther south in Nevada in Gypsum Cave there is evidence that the giant sloth lived some 10,000 years ago. And thousands of miles to the south on the very tip of South America another cave yielded similar evidence of the giant sloth of just about the same age. Human bones and things men used were not found in Gypsum Cave or in Mylodon cave of Ultima Esperanza, but man and sloth were found together in another Chilean cave just 125 miles away, with an age of 8,500 years determined.

Ten millenia, more or less, ancient man had evidently made his way from one end of the two continents to the other, although the oldest human evidences between out northwest and the southernmost South America are dated at about 6,500 years for pre-ceramic charcoal in Mexico, and Peruvian mound wood of somewhat older than 4000 years.

One of the big surprises in the radiocarbon dates is the antiquity of archaeological sites in the east, particularly in New York State. There there lived about 5,000 years ago a long-headed and narrow-faced people who made implements of bone. That is shown by the radiocarbon dating of the charcoal of their hearths, associated with their skeletons. These hunting and fishing archaic Lamoka people mixed with broadheaded, broad-faced humans who chipped stone for their weapons and tools.

Later pre-Indian cultures had pottery, smoking pipes, grew corn, and worshiped the dead. In addition to the

5000 year date for the early archaic period, radiocarbon dating for the transition in these pottery-using cultures in New York is about 3,000 years, nearly 2,000 years earlier than previously estimated.

The beginnings of agriculture in this part of America are pushed back through the discovery of a corn cob under a burial of about 1,000 B.C.

Thus New York in its early archaic people claims early man contemporaneous with middle stone age men of Europe. And these early New Yorkers are of the same general age as the Kentucky mound builders.

Boston, not to be outdone, has a fish weir made of stakes unearthed three years ago in Boylston Street that seems to be of the same age, about 5000 years ago.

In the new dating, the Eskimos are shown to be a relatively young people, with some of them dating a mere thousand years or so in the past. In fact, there seems to be good reason for believing that the Eskimos, at least some of them, are derived from the ancestors of our Indians, rather than the other way around.

In the future, every archaeologist will bring back not alone specimens for museums, but specially selected samples that will be analysed for age by the radiocarbon method.

As the number of such critical age tests increase, the prehistory of our world will be written with more assurance. Some supposedly venerable specimens will lose their claims to fame, and occasionally a surprisingly youthful fragment of the past will take on unexpected age.

Nerve Gas Relatives Fight Plant Diseases and Insects

How Deadly Are Plant Chemicals?

by SAM MATTHEWS

► U.S. FRUITS and vegetables are grown today under a vast fog of chemicals. The chemicals are deadly to insect pests and plant diseases. Sometimes they are also dangerous to human beings.

Just how dangerous are such modern-day farming miracles as DDT, 2,4-D, parathion—and half a hundred other insecticides and crop chemicals—was the concern of scientists and government experts who met in Washington for eight months this year. They attended hearings which were part of an extensive study by the Food and Drug Administration of crop control chemicals used on today's truck farms and orchards.

More than 9,000 pages of testimony and over 1,500 exhibits were presented. In the larger sense, the hearing offered overwhelming proof for one already-established premise: Chemicals are vital to modern farming. Without them, fruit and vegetable growers would fight a losing battle.

The chemical companies' assertion that insecticides, fungicides and herbicides are vital to successful farming was backed up solidly. Technical experts from the Department of Agriculture, followed by representatives of state agricultural offices and research stations and a dozen farmers' and distributors' associations, said much the same thing.

Unless insects and crop diseases are fought by farmers and growers, they testified, the amount of food fit for human consumption would be drastically reduced. And chemicals, in many cases, are the only effective weapons against such natural enemies.

The most important question is, however—how toxic are these chemicals to man? Experts from the U.S. Public Health Service, FDA, Department of Agriculture and a score of U.S. chemical companies brought jammed briefcases as the session moved through the long list of modern agricultural weapons.

First on the list was a familiar name to farmers: lead arsenate. In use for more than a generation, lead arsenate was the subject of protracted hearings 20 years ago which were very similar to the present investigation.

Other chemicals used by growers include DDT, parathion, toxaphene and octamethyl pyrophosphoramide, the last a member of a new family of insect killers called systematic poisons. These make the plants themselves poisonous to insects. They are absorbed in the plant system, from the soil.

Yet as new agricultural chemicals have been improved in pest-killing properties, they also have become more dangerous to their users. With parathion, an insect killer now widely used on U.S. fields and orchards,

men on the big spray rigs have only two choices: Wear a gas mask or die.

"Nerve-Gas" Insecticides

There is good reason for the bold-face, urgent warning carried on each drum of this compound and of other new chemicals widely available to American farmers.

For while military authorities have kept "Top Secret" stamped across weapons developed originally by Germany in World War II, the nerve gases, a close cousin of those same weapons has been in use in this country for at least two years against insect pests.

Some of the effects of parathion on warm-blooded animals, and that includes man, were described by witnesses at the Food and Drug Administration hearing.

Inhale too much parathion vapor or absorb too much of the liquid or dust through your skin. In quick succession your muscles begin to twitch, you find it hard to breathe, your nose and mouth begin to water. Then come gasping, diarrhea, convulsions, unconsciousness and death.

This has happened to more than a dozen farm workers and chemical packers in the last two years, Dr. John P. Frawley of the Food and Drug Administration told Science Service. Seven men died last year from parathion poisoning. Several have already died this farming season.

Even more toxic than parathion are two other insecticides. These are TEPP and HETP, or in full chemical designation, tetraethyl pyrophosphate and hexaethyl tetraphosphate.

Respirators are an essential in handling these chemicals, all members of a deadly family of organic phosphates. Rubber gloves, boots, hat and raincoat are advised, for the poisons can be absorbed easily through the skin.

Why use these dangerous substances at all? Because they are among the most effective insecticides yet developed. Fruits and vegetables on which parathion can be used to cut down insect losses include apples, pears, plums, peaches, beans, beets, cabbage, carrots, corn, onions, peas, potatoes, and tomatoes.

Parathion kills mites, moths, aphids, the Mexican bean beetle, armyworm, corn borer, corn earworm, thrips, Colorado potato beetle, red spider, grasshoppers and the Japanese beetle.

Only in extremely heavy doses would parathion residue on fruits and vegetables reaching market prove dangerous to consumers, experts from the Food and Drug Administration and industrial laboratories testified at the legal tolerance hearings.

Dr. Frawley said long-term Government experiments showed that two-tenths of a milligram of parathion per thousand grams of a rat's body weight produced no ill effects. In man, he said, one-fourth of that amount or about 3.5 milligrams for a 150-pound human being would be well within all safety limits.

Dr. Clinton H. Thienes, head of the department of pharmacology at the University of Southern California School of Medicine, had a higher estimate. Man can take 50 milligrams (about 2/1000 of an ounce) of parathion in a day without suffering any

adverse effects, he said. Parathion, however, is only one of a class of new insecticides.

Another new insecticide called E-838 or "Potasan" has recently joined the list of deadly chemicals which make the modern American farm a very dangerous place for the insects—and sometimes for the men who fight the insects.

The new insect poison is a close cousin of parathion. Like parathion, E-838 was discovered originally by a German chemist, the brilliant Dr. Gerhard Schrader of I. G. Farben, during a wartime search for poison gases.

Dr. Schrader produced the so-called "nerve gases", incredibly toxic compounds that were never used in the war. Among the same chemical family, the organic phosphates, were substances which proved to be potent insecticides—parathion, TEPP, HETP and now E-838, developed within the past two years.

Such phosphorous compounds, being linked to the nerve gases, are all dangerous to man. The American Medical Association has warned that extreme caution must be used in handling these new insecticides.

But evaluation of the health hazard to the U.S. consumer, rather than to the farmer, from these and other modern day agricultural chemicals was the goal of the residual tolerance hearings.

Beginning in January, 1950, and lasting into September, the hearings considered nearly all chemicals used as insecticides, fungicides and weed killers today. Final goal of the project—after lengthy briefs have been filed by witnesses and a proposed set of regulations battled out in draft form—will be a new set of Federal rules stating the permissible amounts of chemical residues on fruits and vegetables traveling in interstate commerce from truck farms and orchards to the nation's dinner table.

On the Back Cover

➤ IRON and sulfur as combined in the mineral marcasite form the pattern of dots recorded in this photograph. The image results from diffraction in two stages. In the first stage X-rays produce a diffraction pattern when they are diffracted by the planes of the marcasite crystal. The second stage, which is made possible by a new apparatus recently devised by Prof. Martin J. Buerger and Jay W. Lathrop of the M.I.T. geology department, is

produced by projecting visible light through the mechanical equivalent of the X-ray image. This light can be focused and recorded on photographic film.

"The spots in this photograph", Prof. Buerger says, "are a faithful representation of the electron density in the crystal; the dark areas are iron atoms with 26 electrons each, and the lighter circles are sulfur atoms with only 16 electrons each".

Bauxite is not only the principal ore from which aluminum is produced, but is also the basic raw material for several industries, including abrasive, chemical, oil-refining, refractory and others.

Chemist Learns About Molecules As Blind Man Might Study Ducks

Sizes and Affinities of Molecules

by DR. J. S. SIMONS

Coordinator of Fluorine Research and Professor of Chemical Engineering, University of Florida, formerly Professor of Physical Chemistry, The Pennsylvania State College.

► THE INDIVIDUAL molecules of most substances, as for example water, oxygen, nitrogen, etc., are so extremely small that it is completely beyond our ability to see them even with the most searching microscopes. The air consists of such molecules, and even the enormous numbers that occupy the space about us give little restriction to our vision. An ounce of water has about 1,000,000,000,000,000,000,000 (trillion trillion) individual molecules, and this produces only about two cubic feet of steam. As all substances are composed of molecules, the properties of the individuals are extremely important to the scientist; and much effort is spent on devising means of determining these properties or of inferring them from the bulk properties of matter.

Models can be made representing these molecules as an aggregate of colored balls, the balls representing the atoms of which the molecules are composed, or pictures can be drawn showing various ellipses and circles in a variety of colors to represent the supposed orbits of electrons. The scientist knows full well that there is no possibility of verifying these models or pictures, but that they are useful to him in representing the properties which he assigns to the individual molecules. Regardless of the architecture of the interior of a mole-

cule the properties that can be observed without disturbing this are of considerable importance.

Molecules either of the same kind or of different kinds attract one another. It is the attraction of molecules of the same kind that holds them together as liquids or solids. If water molecules did not have a considerable attraction for those of like kind, liquid water would certainly be a gas at ordinary temperatures. Sometimes the attraction between molecules is so great that they become firmly attached together to form a molecule of a new chemical substance. All molecules exhibit this force of attraction in varying degrees, both for molecules of like kind and those of different kinds. If the temperature is lowered sufficiently, which means that the velocity of the molecules is reduced sufficiently, molecules, regardless of kind, will condense together to form liquids or solids.

Molecules also repel one another. When they are pressed together in liquid or solid they resist pressure, and the more pressure that is applied the greater is their resistance. We have concluded, therefore, that at relatively large distances all molecules attract one another, and when the distances are very small they repel. The attraction is important in many ways such as in the making of new chemical substances, in the strength of mater-

ials, in the adhesiveness of glue, etc., and the repulsive properties give the bulk to all known substances. If it were not for the fact that all substances are compressible to a greater or less extent—and even the individual molecules are compressible—we might conclude that the bulk properties were caused by the molecules having a fixed and definite size. If they are compressible, however, their size will depend upon the amount of pressure, and this would lead us to the conclusion that the size is not a fixed and definite thing like the size of a steel ball. One reason for this is, of course, that the outer layer of the steel ball is composed of molecules and when we reach this layer of molecules, we reach the surface of the steel ball. An individual molecule obviously does not have such a layer of molecules to form a skin around it.

If molecules are beyond the range of even the most elaborate microscope, how can their properties be observed and particularly how can these attractions and repulsions be measured? As these properties form the basis of the use of most substances, this is a question of considerable importance. The scientist, of course, is always pleased if there is a property he can observe. He is much more highly pleased if this property can be measured. Many techniques have been devised and are used for measuring the various properties of matter and from them inferring the properties of the individual molecules. As even the smallest particles of matter usually contain many millions of molecules, it would appear desirable to be able to observe the properties of the individual molecules and more particularly

to measure them. The number of means for doing this is more limited. At the Pennsylvania State College, a technique is in use for this purpose. It consists of bombarding molecules of gas at very low pressure with electrically charged molecules called ions and observing the effect on the ions after passing through a gas. We can see how this might be done by the following analogy.

We'll assume that one is completely blind, for after all we are all blind in regard to observing individual molecules. Let us assume also that we have a shotgun securely fastened to one end of a room and aimed at a target consisting of a piece of paper at the other end of the room. If the shotgun is discharged, there will be produced a pattern of holes in the target paper. The blind person could feel these holes and become acquainted with their distribution. Now let us place a duck between the gun and the target. The blind person will recognize a difference in the pattern that the shotgun produces under these circumstances. If many ducks were used, he might even begin to recognize, by feeling the target paper, ducks of different sizes, whether they had their wings stretched, and things of that nature. In other words from the pattern of shot he would begin to be able to determine certain properties of ducks.

The experiment can be varied by using shells with greater or less gunpowder to give the shotgun greater or less power. By this means he could obtain further knowledge relative to the ducks. A higher speed shot would penetrate the softer and less dense parts of the bird and would reach the

target. After the blind person became acquainted with all the properties of ducks in this way other birds could be used, and finally the means of learning the properties of birds by a blind person is evolved, by which the blind person could feel the targets that had been used in these ballistic experiments.

Of course, with molecules the projectiles need to be of extremely small size and streams of gaseous ions, i.e., electrically charged molecules, are used for this purpose. Instead of a piece of paper for the target, electrically measured devices are used for the detection of the ions after passing through the gas. An individual molecule cannot be held directly in the stream of projectiles. A large number of molecules are used in the form of a gas. In order that there shall not be too many molecules, the pressure of the gas is very low—somewhere from one millionth to one hundred millionth of the atmospheric pressure. This pressure has to be measured accurately, and instruments have been devised which can do this to an accuracy of better than 1%. The electrical currents formed by these ions collected on the target are very small, but very precise electrical measuring devices have been made and currents can be precisely measured in the range of a millionth millionth of an ampere.

At first sight it would appear that the size of the duck in our ballistic experiments would be exactly given by a shadow pattern on the target where there are no holes made by the shot. If the bird were made of a piece of steel this would be nearly correct, but for a real bird some shot going

through the feathers or softer flesh would proceed to leave its mark on the target. The higher the velocity of the shot, the smaller would be the shadow pattern on the target because the more rapidly moving pieces of metal could penetrate greater amounts of the ducks without being too greatly deflected from the pattern. The size of the duck that the blind person would appreciate, therefore, would depend upon the speed of the projectiles. It would also depend to some extent upon his ability to obtain the precise location of the holes on the piece of paper by means of touch.

To an even greater extent the size of a molecule as determined in our actual experiments is dependent upon the particular dimensions and precision of the equipment used and also upon the speed of the particles which we use to make the measurement. The size of a molecule is not something to which we can give a fixed and absolute value. It is necessary to describe the method that is used and the equipment employed, as these influence the result. Another way of illustrating this is to imagine a feather pillow in the next room and six boys each provided with a foot ruler and instructed separately to go into the room and measure the height of the feather pillow. It would be expected that six different answers would be obtained. Each of these answers is correct, for they are dependent not only upon the feather pillow but also upon the exact procedures the boys used to make the measurement.

Once it is recognized that the size of a molecule is very much dependent upon the method of determining the

size and particularly upon the speed of the projectile on the scattering experiments, it becomes apparent that this change in size with conditions can be used as a means of studying the properties of the molecule. To illustrate this let us replace the duck in our ballistic experiment with a powerful steel magnet and instead of lead, let us use iron shot. The iron sphere passing near the magnet will be attracted to it and its path bent. The place that it shall strike the target will be dependent upon the strength of the magnet. The stronger the magnet the more the path will be bent. The faster the shot travels the less it will be bent. By a searching study of the target path using magnets of different strength and shots of different speed, it would be possible to devise a method of determining the strength of the magnetic field by this means. Also by causing the shot to move at different distances from the magnet we could determine the change of the magnetic field with distances from the magnet.

If now we apply the same reasoning to our molecules, one can perceive that we could devise a method for studying the attracting force of a molecule for the particles used as projectiles in the scattering experiments. This is what is actually done in the physical experiments, and it is thus that the force laws are obtained. From the laws of force we can calculate the energy of combination. To express it simply, any single experimental determination in our scattering experiments gives us measurement of the size of the molecule of the gas. By studying the manner in which this determination of the size changes with

the experimental conditions, we obtain a measure of the forces between the molecule and the projectile particle.

Ammonia is a gas at ordinary conditions, the molecules of which consist of one atom of nitrogen and three atoms of hydrogen. This gas can combine with hydrogen ions (protons) to form what is known as the ammonium ion, which is a positively charged particle having one nitrogen atom and four hydrogen atoms. This ion in combination with negative ions forms the ammonium salts. In combination with chloride ion it forms ammonium chloride or sal ammoniac. In combination with the sulfate ion it forms ammonium sulfate, which is used to a considerable extent in fertilizers. By scattering experiments in which protons of different velocities are scattered in ammonia gas it is possible to measure the energy of combination of the ammonia molecule with the hydrogen ion to form the ammonium ion. The hydrogen ion also combines with water molecules to form what is known as the hydronium ion which is present in all acid solutions and is responsible for the acidic properties. The energy of this combination is measured in a similar manner.

Between the positive ions used as projectiles and the molecules of the gas through which they pass a very interesting occurrence sometimes takes place. After the ion has passed by a molecule it sometimes happens that the molecule now becomes positively charged and that which was formerly the ion has become a neutral gas molecule without charge. In some way an electron has left the molecule and gone to the ion to neutralize the

charge of the ion. The scattering experiments enable this kind of happening to be studied. The ions produced from the gas molecules can be collected separately from the ions of the original stream and measurements made upon them. The phenomenon of the exchange of electrons between a molecule and an ion is important in the production of hydrogen atoms for the hydrogen torch. In the atomic hydrogen torch a stream of hydrogen atoms is directed against a piece of metal that it is desired to heat, as for example, in welding. At the surface of the metal the hydrogen atoms

combine to form hydrogen molecules and liberate a very considerable amount of heat. The hydrogen atoms are produced by passing a stream of hydrogen molecules through an electric arc between two tungsten electrodes. The arc makes initially hydrogen ions, which are positively charged hydrogen atoms. To facilitate the transformation of these positive ions to neutral hydrogen atoms a small amount of water is present in the gas stream. By the process of electron exchange, the water molecules provide electrons to make hydrogen atoms from hydrogen ions.

Mexican Seed-Pod Yields Tannin

➤ THE SEED-POD of the cascalote tree from nearby Mexico is a promising rival to the wood of the Argentine quebracho tree as a source of tannin for American leather. The Armour Research Foundation of the Illinois Institute of Technology, which operates a research laboratory in Mexico City, also finds the Mexican product is satisfactory for use in controlling the viscosity of the so-called muds used in drilling deep oil wells. Some 40% of the South American quebracho product imported to this country is used for this purpose. Pumped down the hollow shaft that carries the rotating drill, these muds lubricate the drill, and bring the cuttings to the surface through the space surrounding the drill shaft. Proper viscosity is essential, and to secure it an additive to the usual clay-water mixture is needed.

Gascalote has long been used in Mexico in a crude form for leather tanning. The new development is a process that yields a stable concentrated extract of tannin suitable for export. The cascalote tree is plentiful in certain sections of Mexico, and only the seed-pod is used to obtain the tannin. Quebracho trees in South America are becoming less plentiful because the tree must be cut down to obtain its extract.

The United States imports of quebracho in recent years have been about 100,000 tons annually at a cost of about \$40,000,000 a year. About 90% has come from Argentina, whose price control policies and recent Anglo-Argentine trade pact discussions have tended to make U. S.-Argentine trade more difficult.

Major mineral elements in plant growth are nitrogen, phosphorus, calcium, magnesium, potassium and sulfur; essential "trace" elements include iron, manganese, and boron.

New Paper Source Found As Spruce Trees Dwindle

Beaten to a Pulp

From the INDUSTRIAL BULLETIN of Arthur D. Little, Inc.

► **HARDWOODS** are now becoming an important source for wood pulp, after decades of limited use, as stands of softwoods dwindle and demand for paper grows. Two high-yield processes are in use for making hardwood pulp; one new one makes "groundwood" for newsprint and other products, and the other, developed in 1926, is now being widely used for paper for shipping containers. Both processes combine aspects of the chemical and mechanical methods of making pulp.

In making pulp, the objective is to separate the cellulose fibers of the wood, either by grinding the log against a grindstone, or by cooking wood chips in any of a variety of chemicals to dissolve the lignin and then washing the lignin away. Both these methods are better suited to the softwood of Northern spruce or Southern pine than to the second-growth hardwoods, such as birch, maple, and beech. Hardwood fibers are shorter than those of softwoods, and contain cells that vary in shape and size. Despite the short fibers, however, pulp from the new groundwood process for hardwoods is said to equal or surpass that from spruce.

The new groundwood process, called Chemigroundwood, was developed at the New York School of Forestry, in a program sponsored by a group of paper manufacturers, some of whom are now putting the process into commercial production. Whole

logs are prepared for grinding with a six-hour treatment in hot neutral sulfite liquor. Initial vacuum, followed by the chemical under 200 pounds pressure, aids penetration of the liquor into the wood. After this softening, it is ground to give a high yield of pulp. The fibers are more completely separated than in regular spruce groundwood, and there are no broken fiber bundles. It is said to bleach to a whiteness comparing favorably with ordinary bleached groundwood. Various mill tests indicate that the pulp can be used in newsprint, tissues, some book papers, and types of paperboard. Paper napkins from the pulp have been successfully tested in retail markets. Because of the high yield from hardwoods, which are cheaper than spruce by the cord and also heavier, the production cost of pulp from the Chemigroundwood process is said to be about \$40 a ton, or about two-thirds the current price of spruce groundwood.

The older process, called "semi-chemical" and developed by the U.S. Forest Products Laboratory, has awaited mechanical adaptations and the right economic conditions to give the spark to expanded production. Several mills in hardwood areas have adopted the process. The logs are reduced to chips, which are digested with a relatively weak, low-cost cooking liquor. There are many modifications of the original formula for this

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► PULP in the beater, ready for manufacture of paper. New processes for preparing wood allow paper to be made from many kinds of wood fiber.

liquor; a recent variation consists of merely soaking the chips in a solution of caustic soda at room temperature. The softened chips readily break down under mechanical treatment in water to the point where conventional paper mill equipment can turn the product into paper. The pulp is only partially cooked or softened and contains much of the lignin and other non-cellulose portions of the wood, thus increasing the yield. These processes have been used mostly in the manufacture of pulp for heavy box-boards and corrugated paper, where weight and stiffness are desirable and the color imparted by the lignin is not objectionable. Recent work has shown that semichemical pulps can be

bleached for book, bond, tissue, and glassine papers.

Although this process was originally developed for hardwoods, it has also been extended to Southern yellow pine. For many uses the lower-cost long-fibered pulps produced by this method compare favorably with pulp made by the older and more costly sulfate or kraft process. Hardwoods were actually the first to be used when the demand for paper began to exceed the capacity of the rag paper processes brought over from Europe. As the easy-grinding poplar became scarce, however, and other hardwoods proved unsuitable, spruce became the chief source of groundwood, and yielded a pulp of high brightness, with good

color and strength. The sulfite cooking process produced pulps with long, strong fibers from the Northern conifers and the sulfate or kraft process, developed for Northern pines, was adapted to the Southern pines. Except for a limited use in book papers and other specialties, hardwood pulps have not been able to compete economically with softwood pulps made

by the chemical processes.

Many softwood species do not reproduce themselves readily when cut, but frequently come back after cutting or fire to mixed hardwoods for the second growth. The two processes now being put into use should go far toward utilizing the plentiful supplies of hardwoods now available in both North and South.

PENNY

By Harry Haenigsen



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**A Versatile Technique
For Separating Mixtures**

Chromatography Comes of Age

FROM RESEARCH, a bulletin of the California Institute of Technology

► NEW UNDERSTANDING of many complex organic chemical compounds can be expected from work now in hand at the California Institute of Technology using chromatography, a versatile technique for dividing mixtures into the individual chemical compounds of which they are composed.

Chromatography is being widely and rapidly adopted by scientists working in many different fields of research. The reason is that it can often resolve a complicated mixture even when none of the usual chemical and physical levers—the still, the centrifuge, the solvents, the precipitators, and so on—can pry that mixture apart.

The many scientists at the Institute who are using the chromatographic technique are quick to point out that chromatography is not a new idea. It was largely the brainchild of Michael Tswett, a Russian botanist and microbiologist who published a pioneer paper on the subject in 1906; and the cylinder of adsorbent material that is the hallmark of chromatography is still known as the Tswett column. But Tswett's brainchild lay unnoticed for many years, and only comparatively recently have chemists and biologists begun to develop the seemingly unlimited possibilities of the method.

Chromatography relies on the capacity of each chemical compound for being adsorbed on the surface of solid substances. This adsorption is caused by unoccupied electrical forces on the

surface of the particles which compose the substance. These surface forces can attract—adsorb—molecules from a solution and hold them firmly. But the strength with which these forces attract the molecules depends, in part, on the character of the molecules themselves, so that “adsorbability” varies from one type of molecule to the next. It is the difference in adsorbability between the molecules of various chemical compounds that makes chromatography work, and the way it works in a Tswett column is this:

A large glass cylinder is tightly packed with some powder such as calcium carbonate, alumina, or sugar. A solution of the substance to be separated into its components is poured onto the top of the column. The component most strongly attracted to the column material—with the greatest adsorbability, that is—occupies a top zone on the column. Other compounds, less strongly attracted, form zones below the first, in order of their adsorbability. The separation into zones is assisted and made more efficient by washing the column with a suitably selected solvent, which increases the distances between the zones.

After the separation into zones in the column is completed, the glass tube containing the “chromatogram” is laid on a table, and the column of powder is forced out of the tube, like a sausage, with a wooden pestle. It is then a simple matter to cut the column into

sections, each containing a single component of the original mixture.

Often the separate zones are colored; there may be, for example, a red zone, an orange zone, and so on. In this case one look serves to indicate where to cut the column. When color fails, fluorescence often succeeds; ultraviolet light in a dark room may indicate the location of the zones when the compounds in them are fluorescent. Sometimes streaking the extruded column along its length with a brush will locate zones that are by themselves neither visible nor fluorescent, if the brush carries a reagent which develops color with the zone material.

That is chromatography in its simplest, and original, form. Two modern variations of the original method increase its versatility, however.

New Ways of Using Paper

The first of these variations is the so-called "paper chromatography" recently introduced by British investigators. A drop of the substance to be separated into its components is placed near one corner of a sheet of paper. The paper is then put edge-down in a solvent, which, as it is soaked up by the paper, spreads the components of the original substance up along one edge of the sheet, each component taking up a zone as it might in a Tswett column. Then the paper is turned 90 degrees and put in a second solvent, which moves the spread-out components in a new direction perpendicular to the first. The result, after the paper has been dried and treated, is a number of spots at various places on the paper—each spot representing a concentration of one of the components of the original substance.

One of the latest developments in chromatography is a cross between the original Tswett column and the paper technique. Developed in the Biology Division of the Institute, it is called the "chromatopile."

The chromatopile is a stack of regular, round filter papers (like those used in some kinds of coffee-maker) compressed between metal plates until it is about a foot high. For a typical separation problem, the top few papers are impregnated with a solution of the substance to be resolved into its components, and a solvent poured down onto the stack of paper through a hole in the top metal plate. As the solvent works down the pile of papers, carrying the unknown material with it, zones like those of the Tswett column again appear. In the simplest case, the experimenter can tell the zones apart by inspection and, using only his fingers, separate the filter-paper discs that belong to each zone.

Another contribution that the Institute (in this case, the Chemistry Division of the Institute) has recently made to chromatography goes back to the Tswett column itself; goes back, specifically, to the adsorbent material used in the column. It is not always possible to find an adsorbent that has greater attraction for the compound in which you are interested than for other compounds found with it. But it has now been found that, by preparing silica gel in the presence of one particular compound, and then washing away the compound with a solvent, you can get silica gel that "remembers" that particular compound—that has as much as 20 times the affinity for the compound as has untreated silica gel.

It therefore, obviously, is a made-to-order column material.

What the Method Has Done

So much for the methods of chromatography. What good are they?

In industry, chromatography has many uses. It is used in one plant to concentrate and purify streptomycin; in another to separate the plant substances found in alfalfa. A related technique, based on "ion-exchange resins," has recently found applications too numerous to mention. But it is in the laboratory, where it is making possible progress in almost every branch of chemistry, that chromatography itself has the greatest promise.

At the Institute, much of the work based on chromatography has centered around the carotenoids, an interesting set of colored compounds responsible for such varied effects as the orange of carrots and the red of tomatoes. Some of the carotenoids are important to human beings because they are converted, in the body, to vitamin A. With the aid of chromatography, the complex collection of these compounds that exists in nature has been studied and catalogued.

More recently, chromatography has been turned to that troublesome class of compounds known as "cis-trans isomers." It happens that, among the millions of variations on the carbon-hydrogen theme that make up organic chemistry, there are many compounds that have the same kinds of atoms in their makeup, the same number of each kind, and have the whole collection hooked together in the same order—and yet are different. The difference lies in the shape of molecules that compose the compounds. These molecules may be straight, or bent in

the middle, or shaped otherwise, and it is this geometrical difference that separates a *cis* isomer from a *trans*.

By ordinary chemical standards, this geometrical difference is one of the smallest possible differences between two substances, and two such substances are accordingly very difficult to tell apart—even though they may have widely differing effects on a living organism. However, because adsorbability depends on the general shape of a molecule as well as on its chemical makeup, chromatography is quite adept at separating the various molecular forms of one and the same compound. It has been useful in this way in the Institute's work on carotenoids.

Another class of bothersome compounds to which chromatography is now being applied is that comprising proteins. Proteins, the substances that make up (and hide most of the secrets of) living organisms, are composed of very large molecules, containing many thousands of atoms. But the very size and complexity of protein molecules has made them difficult to handle, from the chemist's standpoint; and he has been particularly handicapped by the fact that many proteins are oversensitive to his rough handling. In other words, quite often the chemist trying to separate one protein from others damages it hopelessly.

Work being done at the Institute, and elsewhere, on the problems of protein separation indicate that not only will chromatography be able to draw some fine distinctions in the protein field, but that it may be possible to devise chromatographic methods that will not do such extensive damage to the materials under study.

Viruses and enzymes

In the case of the building-blocks of which proteins are composed, the amino acids, chromatography is also helpful. It is now possible to do an amino-acid survey of, say, a virus—to determine just which building blocks form the virus structure—far more quickly and reliably than was possible with older methods. And, using chromatography, the biochemist can tell not just which amino acids, but *how much* of each amino acid occurs in that particular virus, even when the older approach would have led at best only to rough proportions. Amino-acid studies of this sort may ultimately have an extensive effect on the knowledge of life in general and of how to protect it.

A final example of what chromatography can do, and where it may lead, is provided by work now being done by the Institute's Biology Division on enzymes. Enzymes are the tools that living cells use to convert

raw materials to forms more suited to their own purposes; and, because they are partly protein, any chemical work with them is extremely complex. The current research project has demonstrated, however, that a chromatopile can break down an ordinary enzyme preparation into several zones—each zone containing enzymes with abilities slightly different from those of the enzymes in the zones above or below. This is not so much a matter of separating enzymes, because the zones overlap (though it is a step in that direction). But it is a new way of prying into the important secrets of the enzyme problem.

What may come of this work is, of course, unpredictable, as is the result of much of the chromatographic work now going on. However, since the method is an extraordinarily selective and efficient way of isolating each element of a complex chemical puzzle for individual study, the long-term prospects are excellent.

Sturdier Staff of Life

► BREAD can become a sturdier staff of life if the amino acid, lysine, is added to it.

Rat feeding studies showing this were reported by Drs. Hans R. Rosenberg and Edward L. Rohdenburg of the Du Pont Company biological laboratory at New Brunswick, N. J., at the Chicago meeting of the American Chemical Society.

The rats grew better on bread fortified with lysine than on the same type of bread without the lysine.

Lysine is one of the eight amino acids, or protein building blocks, essential to man. Wheat protein does not contain very much of it and milling processes further reduce the amount of lysine in flour. Eating enough meat, milk, eggs, cereals and ordinary bread supplies all the lysine needed for proper nutrition. But if the diet has to be skimpy on the meat-milk-eggs group, lysine fortification of bread might be considered.

Detergents of the Future

by Dr. A. L. Fox

Director of Research, Colgate-Palmolive-Peet Corp., Jersey City, N. J.

Reprint of a paper presented before the 27th annual meeting of the American Institute of Chemists.

► THE assigned subject—Detergents of the Future—is a relatively safe one, because the future represents a long time; prognostications made can always be defended on the basis that 'the future has not yet arrived.' Inasmuch as this meeting is a midcentury meeting, the subject presumably means the detergents of the next fifty years. This also is relatively safe, because the speaker does not expect to be present at the end of the period to defend the predictions. In view of the fact that synthetic detergents have been on the market for only about fifteen years, and in view of the tremendous strides made in these fifteen years, it is obvious that prognostications for the future are very hazardous. Therefore, this paper must come in the category of 'crystal gazing' of the purest type.

It should be made very clear at the outset that the entire synthetic detergent industry is one of intense economic competition. It must not be forgotten that the detergents are in competition with soap, which is inherently cheap (under normal conditions). Therefore, detergents must either do a better job in order to command a premium price, or they must do the same or better job at the same price. This adds up to the fact that detergents do have an economic ceiling which is fixed by the price of soap.

Many sellers of raw materials set their prices on the comparison of soap costs and completely forget that, in order to utilize present day detergent molecules, expensive other ingredients must be added in substantial amounts in order to make the detergents effective. However, synthetic detergents have made the great strides that they have because they do a better job than soap in hard waters, and—surprisingly enough—they are finding widespread acceptance in soft water areas.

In the future we may expect to find three types of improvement:

1. improvements in the conventional type detergent of today
2. improvements adding properties not now possessed by synthetic detergents
3. changes in physical form

Six major types of ingredients have in the past been employed in synthetic detergents:

1. active ingredients, the organic detergent compound
2. inorganic builders
3. organic builders
4. foam boosters
5. anti-redeposition agents
6. brighteners

Practically all of the present day synthetic detergents have anionic active ingredients. These are based on alkyl aryl sulfonates and on alcohol sulfates

in the largest degree. In the next 50 years we may expect to see new active ingredients of perhaps greater efficiency per pound, thereby reducing the cost.

Another type of detergent molecule, which should assume considerable proportions in the future, is the non-ionic. There are on the market at present representatives of this class, and they possess certain outstanding characteristics. Their major weakness to date has been a lack of adequate foam for acceptance in the household field, but it is not difficult to foresee that better non-ionics will be synthesized. Most of those known at present have another deficiency which may impede their progress, and that is that they are liquids. This makes preparation of them in spray-dried form most difficult, although it has been achieved.

Still another major class of organic surfactants are the cationic agents; to date, these have been unsuccessful in breaking into the household detergent field but they are widely used in certain industrial applications. They have certain merits which should make them of potential interest in the future; these will be discussed later.

In the field of inorganic builders for synthetic detergents, the phosphates have been known for many years. This is because they possess a certain detergency of their own and because they have sequestering action for the hardness of water. In the future we should expect entirely new builders to be evolved. While phosphates have been useful in the past, it is not difficult to visualize even better materials. The inorganic chemical companies

have been singularly slow in offering other inorganic compounds which might be used as builders; certainly within the next 50 years it is easy to visualize improved builders not now known. Whether or not these will be based on phosphorus is not predicted, but certainly mixed salts of various elements should be evaluated.

The use of organic builders in synthetic detergents is also known. Long-chain amide derivatives and long-chain alcohols have been described as detergency builders. Inasmuch as organic chemicals outnumber inorganic chemicals by an enormous figure, it is easy and safe to predict that tremendous strides will be made in the discovery and utilization of new organic builders, and this offers a real field for the organic chemical producing companies of the country.

Another type of additive is the foam builder. Here again, such compounds are organic ones, and it is confidently predicted that hundreds of them will be discovered in the next 50 years. Compounds of these types offer attractive potentialities to the synthetic organic chemical companies of the country and should be exploited.

Most, but not all, synthetic detergents have an inherent weakness in that they permit redeposition of soil from dirty laundry water onto fabrics. CMC is one compound having the property of inhibiting this redeposition. For this reason, CMC is widely used, but it is quite expensive, and a cheaper and more effective product will certainly come along in the future. The properties necessary appear to be high molecular weight and a tendency to form micelles; this offers

distinct possibilities for low polymers which are water-soluble. This is, then, a field in which polymer chemists might apply their talents to good advantage and aggressive companies might profit.

The last of the major constituents of synthetic detergents as we know them today are the brighteners. This type of compound has been known for many years and has been used in the paper industry. Brighteners are colorless organic dyes having affinity for cellulose, but which have the ability to fluoresce, thereby making fabrics appear whiter and brighter than they actually are. The brighteners of today have been improved over the past decade but they still leave much to be desired. Inherently, they are not very light-fast, and lose considerable of their potency when the wash is hung out in bright sunlight for extended periods of time. Neither are they particularly fast to chlorine, and many women use bleach in their wash, undoing some of the good of the brighteners. We are confident in predicting that brighteners which are more light-fast and possessing greater fastness to chlorine will be evolved in the future. Here, the future may be defined as a matter of a few years.

Now, looking into the more distant future, into types of detergents not now available, we may first consider the possibility of a cold-water synthetic detergent. If a synthetic detergent could be made which would be as efficient in cold water as present day ones are in hot, it would find extensive use in laundries and in many households. The home automatic washers of today require larger amounts of

hot water than many households can furnish. With automatic washers a cold water detergent would be very welcome. The use of very hot water in laundries has considerable expense attached to it, although it has the value of killing many of the germs on the clothes. It may be predicted that cold-water detergents will be evolved over the next 50 years, which will be very efficient.

Today, far more than half of the housewives use bleach to help them brighten their clothes. Bleach, however, is definitely detrimental to the life of fabrics; consequently it is desirable if something else, not detrimental, can take its place. It is predicted that, in general, synthetic detergents over the next 50 years will be improved sufficiently so that the use of bleach will be absolutely unnecessary.

Many times, women's clothes are mildewed due to leaving damp wash in the basket. It is not unreasonable to assume that a synthetic detergent will be developed in the future which will have anti-mildewing characteristics, and will therefore command the purchasers' attention.

Synthetic detergents today are used to some extent on woolens. It is not unreasonable to hope for mothproofing agents which may be applied to the fabric from a synthetic detergent, so that sweaters washed in this type of detergent would be mothproofed at the same time. The present mothproofing agents known have to be applied under strongly acid conditions, and this as well as their high cost has prevented their use in detergents; certainly it may be anticipated that in

the next 50 years economical moth-proofing compounds will be found which can be used in synthetic detergents, and many manufacturers will wish to add this property to their products.

We hear much today in the press about the unsanitary conditions in the public washing machines, in stores where automatic washers are rented. Most of this is probably inspired for propaganda purposes, but certainly a germicidal detergent would have much to recommend it. It is confidently predicted that in the future such germicidal action will be added to synthetic detergents. Even today some manufacturers claim such properties. Earlier in this paper, cationic detergents were mentioned. Most cationic compounds have germicidal activity, and it may well be that one of the detergents of the future will be cationic, and germicidal.

One of the properties endowed to fabrics by the textile mills is a soft feel, or 'hand'. This is done by means of certain chemicals which make the fabrics much gentler to the touch. Most of these compounds are cationic, and here again it is possible that cationic agents may find a future in this field. Certainly, synthetic detergents which have this added property will be developed over the next 50 years.

Another type of synthetic detergent which has been known in the past, but has been rather unsuccessful, has been the salt-water detergent. It is confidently predicted that in the future greatly improved synthetic detergents will make their appearance and will be used in salt water. This will

be particularly useful on ships and in summer resorts.

Very recently there has been described a treatment for fabrics, a rinse, which minimizes the soiling of the fabric during use, and which causes the removal of soil much more easily after the fabric has become dirty. This treatment is by rinsing with a solution of CMC and was described in a recent release emanating from the Institute of Textile Technology. The present status of this would make it appear that it is too expensive, but it is not unreasonable to believe that a synthetic detergent itself incorporating this property may be developed in the next 50 years. Certainly it would have enormous consumer appeal.

In the next 50 years we may expect to see types of synthetic detergents built for special purposes. Already we have on the market certain synthetics which are especially recommended for automatic washing machines, as they produce low foam, and therefore do not impede the mechanical action of the washers. Many other detergents of this type may be expected, especially as the number of automatic washers in the country becomes greater.

There is on the horizon an entirely new type of automatic washing machine. Certain investigations are being carried out at various places in the world on the use of ultrasonic waves as the mechanical force for removal of dirt from fabrics. In Australia an ultrasonic washing machine has already been offered to the public; evaluation of this does not show it to be particularly effective, but it is probably a forerunner of more effective

types. Certainly new types of detergents will have to be built for such types of washers.

Another boon to the housewife which is rapidly appearing on the American scene is the mechanical dishwasher. It will be necessary to develop synthetic detergents which will be effective in them. At the present time certain inorganic salts are widely used, although there is on the market a very superior product based on a synthetic detergent and still further improvements may be expected.

At the present time, synthetic detergents are offered in bead form and as liquids. There are several liquid dishwashing compounds on the market, and others may be expected to come. This type of market may grow substantially in the next fifty years.

Still another type of physical form which may come is the pellet form, which has the advantage of permitting an accurate gauge of dosage. Many attempts have been made in the past to produce such pellets, but none have been commercially acceptable. However, it is predicted that in the future this physical form will have considerable interest.

Another possible future form of synthetic detergents will be in pressure containers of the aerosol type. Already there is evidence accumulating that shaving creams and shampoos may be a commodity of the future. These would be dispensed in pressure containers and one would merely push a button to have a headful of foam

for a shave. To extend this to household use for clothes washing, is purely an economic matter. It is not too much to believe that in 50 years this idea may find acceptance in a rather limited way, if the cost can be brought down substantially.

Today synthetic detergents have not been used extensively for toilet soaps in bar form. There is on the market today a very superior synthetic detergent in bar form, but it has limited distribution. However, in the long range future certainly such a product appears to be a definite probability.

This, then, concludes the predictions on possibilities for detergents of the future. One last word, however, should be brought in. . . soap, in very soft water, is still an exceptionally fine detergent, and it is believed that if as much effort had been made to improve soap as has been devoted to the development of the synthetic detergent field, vastly improved soaps would be on the market today. There are known certain sequestering agents (one of which is ethylene diamine-tetracetic acid) which, if they were sufficiently economical, could be added to soap, which would make it competitive with detergents in all waters. It is predicted that in the next 50 years very cheap sequestering agents will be developed and will find enormous outlets for mixture with soap. It is predicted, however, that in the long run synthetic detergents will probably overcome packaged laundry soap and at the end of the next half century very little soap will be used, except perhaps as bar toilet soap.

The sweetness of many varieties of sweet corn decreases after it is gathered if not cooked soon.



➤ *LARGEST plastic balloon being filled with helium in preparation for flight high enough to catch cosmic ray records for General Mills aeronautical research laboratories under contract with the Office of Naval Research.*

1/L
ACTIDIONE
in H₂O

PLAIN H₂O



► AFTER a four-days' lack of water, laboratory rats welcome a drink of plain water. They consistently refused to drink from the bottle on the left, containing a trace of actidione.

Rats Hate Actidione

► A CHEMICAL isolated from the versatile *Streptomyces griseus* has proved to be more toxic to rats than to other small mammals, but promises to be useful against rats rather because they won't eat it than for its poisonous qualities. Rats in laboratory cages will go without water for days rather than drink from a supply containing a mere trace of the new chemical.

The *Streptomyces* product was made by the Upjohn Research Laboratories in the course of a study on antibiotic material. It was at first believed to be a di-ketone. Its composition is now believed to be that of a mono-ketone, with the empirical formula $C_{15}H_{23}NO_4$. It is being studied

as a fungicide against plant diseases. The Army Medical Department Research and Graduate School, the Fish and Wildlife Service of the Department of the Interior, and the Army's Quartermaster Corps are all interested in trying out the poisonous and repellent qualities of the new material.

It is the Quartermaster's idea to try impregnating cardboard cartons with a dilute solution of actidione. Since rats in the laboratory shun food that has been dipped briefly in dilute solutions of the poison, it is believed that they will avoid storehouses where the outer wrappings of stored food products have the taste the rats find so unpleasant.

**Chemicals May Conquer
World's Number Three Health Problem**

Snail-Killers Break Disease Cycle

► **CHEMICALS** that may conquer the world's number three health problem have been discovered by scientists of the U.S. Public Health Service's National Institutes of Health.

The chemicals are snail-killers. They may stop schistosomiasis, a disease that attacked nearly 2,000 of our fighting men during the invasion of Leyte in World War II. Our forces in Korea now may be in danger of getting this snail-spread disease, though exact information on this is lacking.

Schistosomiasis is caused by a kind of flat, leaf-shaped worm called a fluke. The fluke spends part of its life cycle in the body of certain fresh water snails. Humans who bathe, drink, wade or do laundry in water containing these snails or the larval form of the flukes are likely to get the disease. The flukes produce their eggs in the human body. These get back into the water either directly from humans using the water or via drainage from land fertilized with human night soil.

The cycle can be broken and the spread of the disease stopped by getting rid of the snails. The chemicals that show promise of doing this are sodium pentachlorophenate and copper pentachlorophenate. They have been used in the textile and wood industries and elsewhere. Their snail-killing power was discovered in World War II-sparked studies at the National Institutes of Health.

Excellent results with them in field trials in swamps, lily ponds, roadside ditches and backwash river waters in Puerto Rico have been announced by Drs. E. G. Berry and M. O. Nolan of the U.S. National Institutes of Health and Dr. J. Oliver Gonzalez of the School of Tropical Medicine at San Juan, P.R.

Four other chemicals proved effective in the field trials, but their present price makes them impractical for this use. The two most promising ones cost about 20 cents a pound. Even shipping charges half way across the world will not bring this up much. Copper sulfate, chemical previously used in the fight against schistosomiasis, costs 22 cents a pound delivered in Egypt.

Copper sulfate has to be applied to snail and fluke-infested waters every two or three months. Even then it does not give very good results. The two phenate chemicals probably will have to be applied only once or twice a year.

To determine just how often they must be used and how often infected snails come back to the treated waters, field trials will be conducted in Liberia.

Further tests of the safety of the chemicals will also be made. They kill catfish, guppies and eels, but not crayfish, the Puerto Rico trials showed. So far as now known, the chemicals will not harm humans or cattle drinking or bathing in the water.

Further tests with rats and guinea pigs in the laboratory are now under way.

Schistosomiasis is the world's number three health problem, coming after malaria and tuberculosis, for two reasons, according to Dr. Willard H. Wright, head of the tropical diseases division of the U.S. National Institutes of Health.

One is the number of persons affected, estimated at 115,000,000 persons throughout the world. In Egypt 75% to 80% of the population are infected and the disease is estimated to reduce the economy and production of the country by one-third.

Second reason is that the disease is a chronic one which makes its victims too sick and weak to work. And there is no good remedy for it. Tartar emetic, an antimony compound, is

fairly effective when given early in the disease to patients who can be protected from reinfection. But this is practically impossible for large numbers of people in Egypt, the Orient and some South American countries who have no sewage and water supply systems and must use ponds and streams for everything from drinking to laundry and irrigation.

Patients may be sick with the disease for anywhere from three months to more than two years and eventually die of it. Symptoms may vary from itching of the skin where the fluke larvae enter to fever and severe generalized pain. The eggs of the flukes are often deposited in the bladder and become the nuclei for the formation of bladder stones. Cancer of the bladder is believed also to result from this disease.

Carbon Monoxide Color Test

► THE STANDARD British method of detecting the presence of poisonous carbon monoxide gas in the air in factories, garages and homes is now a war-developed process, which utilizes a small tube containing silica gel and a yellow reagent that is stained by the gas.

If carbon monoxide is present in the air drawn through the tube, even in very small quantities, the reagent is discolored. A dark brown stain appears at the junction of it and the gel. The length of the stain gives a measure of the amount of carbon monoxide in the air.

The adoption of this method as standard is announced in a recent publication of the British Department of Scientific and Industrial Research.

Several methods of detecting carbon monoxide are presented in the leaflet but this war-developed method is described as best to give a rapid indication of the relative safety of the atmosphere.

The industrial tube recommended by the government agency is relatively small in size and has plain silica gel at each end with the yellow reagent between. This reagent is potassium pallado-sulphite. Air to be tested is forced through the tube by a rubber bulb. The function of the gel is merely to remove condensable vapors.

A version of this same carbon monoxide detector is in use in the United States. It was developed by the National Bureau of Standards and widely used during the war.

New Developments in the Atom

► THE DOUBLE-WEIGHT neutron, for some time considered a possibility among atomic particles, actually exists.

In experiments at the Los Alamos Scientific Laboratory, definite evidence has been obtained for the dineutron, a particle of neutral electrical charge that is double the weight of the ordinary neutron.

Tritons, hearts of hydrogen isotope three, were flung at other tritons by an electrostatic generator atom-smasher. Out of the two tritons' exploding and combining came one atom of ordinary helium and the dineutron, which lives for a very short time and then becomes two ordinary neutrons.

Tritium, three times the weight of ordinary hydrogen, is made in atomic piles. It is radioactive, half of it disappearing in about 30 years.

The dineutron, now proved to exist, is analogous to double-weight hydrogen or deuterium.

Three Neptunium Isotopes

► THREE NEW light-weight varieties of the transuranium element, neptunium, are announced by a University of California team of scientists to the American Physical Society through the *Physical Review*. The new isotopes have atomic weights of 231, 232 and 233 and they are made by smashing heavy hydrogen (deuterium) hearts into heavier atoms of uranium.

Six other isotopes of this element, number 93 in the periodic table, were

known previously. All of the new isotopes live only a matter of minutes, but there is one very long-lived variety of neptunium 237 discovered during atomic bomb research during the war. The new isotopes are believed to undergo fission.

The discoveries were made by Drs. L. B. Magnusson, S. G. Thompson and G. T. Seaborg.

New Helium Isotope

► A STRANGE new kind of heavy helium, mass five instead of the usual four, has been found in the tritium-tritium reaction by scientists at the Canadian atomic energy laboratories at Chalk River. Helium five decays into ordinary helium and a neutron shortly after formation.

Hydrogen Causes Aurora

► THE EARTH has been bombarded with hydrogen—from outside the earth. No hydrogen bomb scare this, although the atomic projectiles reported by the University of Chicago do come from the sun which is past master of changing matter into energy with which to continue to shine. A great auroral display last summer caused the skies to blaze with northern lights. This allowed Yerkes Observatory astronomer A. B. Meinel to determine that the cause was hydrogen gas given off from sunspots. Traveling 1800 miles per second, the hydrogen struck the earth's atmosphere and made it give off light. Scientists have suspected this, but Meinel proved it

by the displacement of hydrogen lines in the boreal spectrum.

Cosmic Ray Bull's-Eye

► THE FIRST photograph at 100 miles above the earth of a cosmic ray smashing an atom to bits has been taken from a V-2 rocket.

The photographic plates recovered in this V-2 flight showed more than three times as many cosmic ray collisions at the 100-mile level than appear 20 miles up.

Prior to the successful photograph from this V-2 rocket, most photographs of cosmic particles smashing atoms were obtained by using free balloons that did not travel higher than 20 miles. Several previous attempts to get good photographs of cosmic rays from rockets were unsuccessful.

The photograph was made possible by a special plate holder designed by Dr. Herman Yagoda and co-workers at the Experimental Biology and Medicine Institute of the National Institutes of Health.

This container protects the fragile photographic emulsions so that they can withstand shocks in the firing and landing of the rocket. It also protects from the vapors of the rocket fuel. Hydrogen peroxide particularly causes rapid destruction of the images.

The energetic cosmic rays that made the stars on the photograph penetrated through the rocket to get a direct hit with the nucleus of an atom in the photographic emulsion. The tiny building blocks of which the smashed atom were made spattered out into the surrounding emulsion. Since many of the particles thus made are charged, they leave tracks in the emulsion that can

be seen microscopically in the developed plate.

Particles In Cosmic Rays

► TO THE STRANGE and almost unimaginable things within the cores of the universe's atoms, have been added at least two new particles which are believed to be "elementary" although with extremely fleeting existences.

They are new kinds of mesons, particles born of cosmic rays. A team of California Institute of Technology physicists, led by Nobelist Carl D. Anderson, discoverer of one of the two most common meson particles (named the Greek letter π), reported to the American Physical Society their capturing of 34 photographs of forked tracks showing the life and death of these new unstable neutral and charged particles. It took 11,000 pictures to get the 34 forked tracks.

Less than three years ago two such pictures of cosmic rays smashing through cloud chambers were obtained by Drs. G. D. Rochester and C. C. Butler of the University of Manchester, England, who presumed they were the spontaneous transformation of unknown particles.

Now there seems little doubt that the particles are real.

The tracks in photographs taken in both Manchester and Pasadena can only be explained by the occurrence of entirely new kinds of particles, charged and neutral. They live an extraordinarily short time, only two ten-billionths of a second, compared with a millionth and a hundred millionth of a second for the usual mesons, μ and π .

The new particles blow up to give two fragments that create the forked

tracks. There may also be a neutral fragment that does not show up on the plate. The charged fragments are not electrons (particles of electricity), but one of these secondary particles is probably a *pi* meson that can interact with the nuclei of atoms through which it passes.

In the research team with Dr. Anderson were: Drs. A. J. Seriff, R. B. Leighton, C. Hsiao, and E. W. Cowan.

Because the universe and everything in it consists largely of the extremely concentrated nuclei of atoms, the great push in physical science today is to understand and explore these atomic cores. Protons (hydrogen hearts) and neutrons are in the nuclei, with the strange mesons (positive, negative and neutral) playing catch with themselves as protons change into neutrons and the other way around. If just what happens is better understood, more energy might be extracted from the atom, in bombs or otherwise.

Pi-Meson's Life Span

► LIFETIME of one of the fundamental particles within the atom is one 60-millionth of a second.

That is the short span of existence of the heavy positively charged meson, called the *pi*-meson, as determined with the new 300,000,000 electron-volt synchrotron of the Massachusetts Institute of Technology.

No satisfactory substitute has been found for the Japanese agar, an important bacteriological medium, or germ-cultivation substance; production from American seaweed is far short of the 600,000 pounds needed annually.

Pulpwood possibilities in Alaska are being surveyed by the government; preliminary estimates indicate enough hemlock and spruce timber to produce annually around 800,000 tons of sulfate or sulfite pulp.

The exact function of these mesons in the nuclei of atoms is still mysterious. The high-energy atom smashers have allowed the artificial production of the particles first observed in cosmic ray collisions.

The M.I.T. scientists, Dr. William L. Kraushaar, Victor P. Henri, and Dr. J. Earle Thomas, Jr., used X-rays smashing into metal to produce the mesons and then detected their disintegrations as flashes of light in an organic crystal of stilbene.

Magnetic Atom Measured

► A NEW USE for radio-frequency circuits is to determine the magnetic properties of the atom. Since atomic particles spin and carry electric currents they behave like small magnets.

Dr. Felix Bloch, professor of physics at Stanford University reported new developments in the study of nuclear magnetism in the journal, *Physics Today*.

Placing these invisible magnets in an alternating magnetic field gives rise to electric forces which can be measured by short radio waves. New information about the structure of matter has been discovered by varying the electric and magnetic forces to which atomic magnets respond, and measuring the time necessary for their response.

Rare Form of Tin Acts Like Germanium

Allotropic Tin A Semiconductor

► TIN is now added to the small list of materials that will act as semiconductors. These substances are extremely useful in electrical applications, and also show promise as photoelectric cells.

Semiconducting tin, however, is not the same form of tin that is so familiar in tin cans. It is a special form of that element, having a different crystal structure. It is related to normal tin in the way that the diamond is related to carbon black. These two are the element carbon in different crystalline modification.

The unusual form of tin was first discovered more than 100 years ago. In 1833, in a church in Germany, it was noticed that certain of the organ pipes were crumbling away. This deterioration of the tin pipes made them look much as if they had been attacked by fungus, and the crumbling was known as "tin disease."

Some specimens of this gray tin, as it is now called, were preserved, although the church organ pipes were replaced. Scientists today are thankful that these specimens were saved, for they find that it is extremely difficult to produce the unusual form of tin without first having seeded the laboratory with the rare crystals.

In 1899 Ernst Cohen, a Dutch physical chemist, discovered that the gray metal found when the church organ pipes deteriorated was an allotropic

form of tin. Little work had been done since then with this material until about two years ago, when Prof. G. B. Busch of the Physikalisches Institut Technischen Hochschule in Zurich investigated its properties.

He presented a report of his work showing tin's promise as a semiconductor to the International Conference on Semiconductors held in Reading, England, recently. Other scientists had independently come to the conclusion that the conductivity of this unusual metal was worth investigation. In this country, Dr. R. G. Breckenridge of the National Bureau of Standards is directing his attention to growing single crystals of the gray metal.

Physicists divide matter into three groups when they are discussing its electrical properties. One group is the metallic conductors, which readily transmit electricity. Another group is the insulators, conducting electricity to a negligible degree. Between these two groups lie the semiconductors. They find use in electric current rectifiers and in the transistor, which amplifies electric currents.

The two most useful materials for semiconductors are germanium and silicon. In the same group with these two elements in the periodic table is tin. Normal tin shows only the expected metallic traits. The rare crystals, however, are in the in-between land of semiconductors.

New Theories of Disease

► A NEW CHEMICAL attack on polio has given scientists at Yale University a working theory of the origin of the virus and clues to the problem of immunity and resistance to it.

The polio virus, according to this theory, is manufactured by cells of the human body, with the first virus that invades the body serving as a template. But whether the virus reduplicates itself or is made by the cells of human spinal cords, the manufacturing process goes on in the nucleus of the cells.

Findings supporting this new approach to the polio problem were announced by Drs. Joseph L. Melnick and John B. LeRoy of Yale University School of Medicine at the Congress of the International Society for Cell Biology.

Scientists heretofore have thought the polio virus existed only in the part of the cell called the cytoplasm, which is the fluid that bathes the nucleus. Finding it in the nucleus may explain, for example, why a person who had polio at the age of two might still have antibodies to the virus in his body at the age of 70 years. Small amounts of the virus may have been locked away in the cell nucleus all the time, giving rise to the antibodies.

How the virus attacks and ultimately causes the breakdown of cells in the spinal cord, the part of the body most severely affected during polio, could also be explained by the new theory.

Within the nucleus is a particle called the nucleolus. The virus may make enormous demands on the manufacturing process in this nucleolus which eventually results in the complete breakdown of the cell structure.

Finding the polio virus in the nucleus of the cells also gives "new light" on the relationship of fatigue to polio.

Many parents as well as doctors know that being over-tired at the time polio attacks makes the victim more liable to paralysis. The proteins of the cell nucleus, Swedish scientists have found, are consumed rapidly after a period of fatigue and are reformed at a much slower rate.

Previral Units

► A NEW THEORY of how disease-causing viruses multiply within the cells of the body was announced by Drs. Geoffrey Rake and Harvey Blank of the Squibb Institute for Medical Research, New Brunswick, N. J., and the University of Pennsylvania and Children's Hospital, Philadelphia, at the Fifth International Congress for Microbiology in Rio de Janeiro.

In the early stages of virus multiplication, according to the new theory, there are "previral units." These are smaller than the fully formed virus particles with which scientists have previously been familiar.

The fully formed virus particles seem to be made up of a number of

previral units around which a matrix of other material forms.

This picture of how viruses multiply within the cell was developed from studies with the virus of *moluscum contagiosum*. This is a skin disease affecting only the superficial layers of the skin. The virus producing it has characteristics placing it in the group of pox viruses which produce such diseases as smallpox, chickenpox and, in animals, cowpox. The lumps on the skin produced by this virus develop slowly, are on the surface of the skin and benign in nature. This makes it easy to obtain large amounts of material for examination.

New and delicate methods of tissue stainings were applied to the infected cells and fragments of cells affected by this virus. They were then examined under the electron microscope. From these studies came the new theory of virus multiplication. It is considered of great theoretical importance because heretofore very little has been known about the early stages of the multiplication of viruses inside cells with the exception of bacteriophages, which are viruses that prey on bacteria.

Anti-Cancer Chemical

➤ SEARCH for a chemical cure for cancer has led scientists to investigate fungi; disease-causing viruses; male, female and adrenal hormones and synthetic chemicals from the textile industry.

One of these synthetic chemicals, called SK 1133, caused complete regression, or disappearance, of almost 100% of the highly malignant cancers called sarcomas, about 80% of carcinomas and about 40% of carcino-sar-

comas in rats, Drs. Kanematsu Sugiura and C. Chester Stock of Sloan-Kettering Institute for Cancer Research, New York, reported at a recent meeting of the American Association for Cancer Research.

A related chemical SK 1424, was almost as effective. The value of both chemicals in treating animal cancers was definitely greater than that of nitrogen mustard.

The virus of Russian Far East encephalitis, cause of the brain disease sometimes called sleeping sickness, also showed striking anti-cancer activity, completely checking the growth of some animal cancers, though it was ineffective against others. The anti-cancer activity of the virus, however, is tied up with its disease-causing activity. The cancer in the mouse would be completely destroyed but the animal would always die of the virus infection. Study of this virus was reported by Dr. Stock and Dr. Alice E. Moore.

Anti-cancer but also toxic to the test animals was a substance from a fungus, *Aspergillus fumigatus* 943, investigated by Dr. Stock with Dr. H. Christine Reilly.

More encouraging was the report that mice expected to develop cancer of the outer part of the adrenal gland can be protected from this fate by pellets of male and female sex hormones and adrenal cortical hormones. Search for a substance with strong tumor-preventing effect without being a "strong sex hormone" is continuing and the outlook, Dr. George W. Woolley of Sloan-Kettering reported, is hopeful.

Cell Chemistry

► A CHANGE in fundamental cell chemistry which might be a first step toward the development of cancer has been discovered by Drs. Antonio Cantero, Roger Daoust and Gaston De Lamirande of the Montreal Cancer Institute and Notre-Dame Hospital.

During the transition stage when a cell is becoming cancerous, enzymes which break down the acid in the cell's nucleus behave differently than they do after the cell has become cancerous, the Montreal scientists find.

They worked with white rats that had been fed a diet of cooked polished rice and an azo dye. This diet caused an irreversible liver cirrhosis which the scientists consider a sign that cancer is going to develop. The enzyme activity of these pre-cancerous rat livers increased progressively up to the 90th day the rats were on the special diet. Then the enzyme activity decreased progressively for the rest of the 150 days of the diet.

Previously it has been shown that the nucleic acid these enzymes affect is changed in cancer. Whether the change is a first step in producing cancer or merely accompanies the development of cancer is not yet defi-

nately known. These studies, however, were made of nucleic acid in normal and cancer cells. The studies of the Montreal scientists, reported in the journal, *Science*, were made on cells during the transition stage between the normal and cancerous state.

Tar May Cause Cancer

► A POSSIBLE cause of cancer may be particles of tar which constitute 10% of the dust in ordinary city air, Dr. Leonard A. Scheele, Surgeon General of the U.S. Public Health Service, told the United States Technical Conference on Air Pollution in Washington.

"I would not have you conclude that city air causes cancer in man," Dr. Scheele said. He reported, however, that a single injection below the skin of these soluble tar particles produced malignant tumors (cancer) in mice.

The substances were collected from the air in streets, homes, offices and schools. Analysis at the Public Health Service's National Cancer Institute have at least raised serious questions as to the role of community air pollution in the causation of cancer, Dr. Scheele stated.

Soil Fumigant for Nematodes

► WESTERN SUGAR beet growers, who regard a tiny worm as one of their biggest pests, now have a new soil fumigant which may help them take a sizable amount of growing sugar back from this parasite.

The fumigant is a mixture of chlorinated hydrocarbons forced into the ground through nozzles, where the

liquid vaporizes and kills most of the roundworms, or nematodes, in the vicinity. Northern Utah farmers who tried it last summer more than tripled their best yield per acre, compared to unfumigated land.

The new treatment is not permanent. It lasts only one year. It is so toxic, moreover, that it must be used at least two weeks before planting.

**Structural Characteristics Which
Determine Plastics, Rubber and Fibres**

Long Flexible Chains

by DR. R. F. HUNTER

Research Manager, Bakelite, Ltd., Birmingham, England.

The molecules which constitute the groups of substances classed as Fibres, Plastics and Rubbers all consist of polymers which in most cases are in the form of more or less stretched out chains. If for plastics, we confine ourselves to thermo plastics, these three groups are all made up of long flexible molecular chains usually containing from 5,000 to 50,000 atoms. These chains attract each other by dipole association and van der Waals forces in varying degree, depending on the polymer units involved and the degree with which they stick or fit together determines whether the substance will be a fibre, a plastic, or a rubber. When the substituents on the main chain possess strong polar attraction for each other, are small, and can fit together neatly, parts of the chain will tend to pack together assuming a regular type of structure and the substance will be a fibre. When there is little attraction between the substituents or these are bulky, the chains assume a much more random arrangement and the substance is a rubber. Thermoplastics represent an intermediate state between these two extremes with a bias towards ordered arrangement of fibres. Substances of one group can frequently be converted into another and most of the new synthetic fibres actually

started their careers as plastics. Fibres can be made from vinyl resins, vinylidene chloride, polystyrene, polyethylene and polyamides. Correspondingly, since the chain molecules are in a state of continuous agitation due to internal Brownian movement, rise of temperature increases this with separation of the chains so that at a certain stage, a thermoplastic is converted into a rubber.

Conversion of plastics into fibres by orientation of the somewhat tangled structures into close packed molecular chains is frequently accomplished by stretching so that the chains arrange themselves more or less parallel in the direction of stretching. The plastic is extruded through nozzles and the extruded material is then orientated by being stretched to several times its original length.

Polyethylene might from the low degree of attraction between the hydrocarbon chains be expected to be a rubber whereas it is actually a tough waxy plastic due to its partly crystalline character which arises from the fitting together of the zig-zag paraffin chains. When a polar hydroxyl group is introduced as in polyvinyl alcohol, the material acquires fibre-like characteristics due to the combination of the effect of hydrogen-bonding with the good fit of the chains.

The effect of chlorine substitution

Read before the meeting of the British Association for the Advancement of Science, Birmingham, Sept. 1, 1950.

in the hydrocarbon chain results in molar cohesion intermediate between polyethylene and polyvinyl alcohol and this together with the larger volume of the chlorine substituent results in the typically plastic properties associated with polyvinyl chloride.

Substitution of ethylene units in polyethylene by the CONH group does not alter the type of packing, but increases cohesion with production of the well known Nylon fibres.

Thermosetting plastics differ from the long chain polymers in that the effect of heat on their properties is *irreversible*. They consist of polycondensation chains of phenolic nuclei with methylene groups which have been permanently "hardened" by conversion into a three dimensional net-

work by further condensation with formaldehyde. On heating a thermoplastic, the macromolecules become separated and are eventually free to slide past each other so that the plastic melts and can flow into a mould. In the hardened or cured thermosetting resins, this is impossible as the original polymer chains are linked by actual covalent bonds.

The three-dimensional structures can be made in two ways, either by small molecules with reactive methylol groups combining into a network structure, or by linear polycondensation chains cross-linking at a number of points. The two stage process involving cross linking is analogous to the process which occurs in vulcanisation of rubber.

Metal From Smelter Waste

► RECOVERY of strategic metals, such as lead and zinc, from waste piles at smelters by a wartime process known as slag fuming is proving a success.

The waste piles are the heaps of slag from ore-bearing rock, the material that remains after ordinary smelting operation has been carried as far as economically possible. This slag, or tailings as it is sometimes called, still contains considerable metal, and salvage of the metal is particularly important where known deposits of the ore are becoming depleted.

The fuming operation, as described by D. V. Sherban of the Babcock and Wilcox Company, is a process in which zinc or lead, in the form of vapor or fumes, is boiled or "fumed" up from the surface of a furnace-load

of molten slag. The vapor is converted into a metallic oxide which is cooled as a solid, or as a powder known as "fume," for further processing into finished metal.

Three installations for slag-fuming have been made in North America.

The first was made in 1943 at Kellogg, Idaho, by the Bunker Hill and Sullivan Mining Company. The second was made in Texas at El Paso for the American Smelting and Refining Company and went into operation about two years ago.

The latest installation is near the arctic circle at Flin Flon, Manitoba, where the Hudson Bay Mining and Smelting Company has an 800,000-ton accumulation of residue estimated to contain 26% of zinc alone.

Materials and Combustion Both Chemical Problems

Improved Engine Designs

► **HIGHER ALTITUDE** and longer flights of commercial airliners with conventional piston engines are possible with a new engine supercharger recently developed by General Electric.

Superchargers are devices to feed sufficient air into the engine to assure maximum combustion of the fuel and consequently give greater power. In the high-up rarefied atmosphere they are essential and fighter planes have been equipped with them for a decade or so.

The new supercharger is particularly suitable for passenger transports. It is called a turbosupercharger because it utilizes turbine power to operate the compressor which forces the air, with its vital oxygen, into the combustion chamber. Spun by the engine's exhaust, this supercharger compresses the rarefied air to sea level pressures before it enters the cylinders.

The new turbosupercharger, called the CH9, entirely eliminates the conventional geared supercharger operating off the engine shaft. There are no mechanical connections between engine and turbo. In tests already made, it was used in combination with a Pratt & Whitney R-4360-C piston engine.

Development of a direct cylinder fuel injection system for the R-4360 eliminated the major need for a geared supercharger which is used to insure uniform fuel distribution to the cylinders. Elimination of the geared supercharger makes possible the sav-

ing of up to 500 horsepower previously drawn from the piston engine.

The CH9 will supply the engine with an airflow of 350 pounds a minute under a pressure of six atmospheres. This is greater than any other turbocharger previously developed. This turbosupercharger will enable airliners to fly greater non-stop distances at greater speeds and with heavier payloads than other commercial powerplants.

Gas-Turbine For Highways

► **THERE IS A PLACE** for the gas turbine engine in highway freight hauling, although the engine is not proved yet and has not reached its maximum in performance and development.

This is the opinion of W. M. Brown, Kenworth Motor Truck Corp., Seattle, Wash., expressed recently at a West Coast meeting of the Society of Automotive Engineers. He reported particularly on recent experimental testings of a Boeing turbine engine installed in a Kenworth truck chassis.

Gas turbine engines have proved efficient and relatively economical in installations ranging from ground power stations to turbo-prop airplane power plants. Many believe that the turbine will replace the ordinary reciprocating engine in automobiles. This recent truck installation at Seattle is a forward step in adapting the turbine to highway motor vehicles.

One particular advantage of the gas turbine engine is the elimination of reciprocating motion and the use of rotary motion. Gases of combustion created in the engine are discharged against fins on a rotating shaft to give very high rotation to the shaft. Special gearing can cut the speed for practical applications.

In the case of the Boeing truck turbine, Mr. Brown stated, a secondary turbine shaft is used. The engine has two combustion chambers. The products of combustion of both chambers are directed through the primary turbine where two-thirds of the energy of the gases is extracted in turning the compressor shaft. The compressor provides air for combustion. The remainder of the gas is led through the secondary turbine where shaft power is produced.

Diesel Engine Efficiency

► THE FACT that there is a steady increase in the number of diesel-powered trucks on our highways indicates that there are sound commercial reasons for their use, engineers were told by F. Glen Shoemaker of the Detroit Diesel Engine Division of General Motors. The most obvious advantage is their well known saving in fuel, both in gallons and in price.

He reviewed the fundamental nature of this advantage. The diesel, he said, takes advantage of the thermodynamic law of internal combustion engines that the most work is obtained when the fuel is burned and expanded as much as possible.

When the compression ratio is increased in an engine burning a gaseous mixture, the fuel ignites of its own accord before the desired high

compression pressure is reached, he said. This means the efficiency is limited by the nature of the fuel.

On the other hand, compression and expansion ratio can be raised very much higher if the fuel is sprayed into the air after it is compressed. Thus by injecting the fuel at the end of the compression stroke, as is done in the diesel, the use of high compression and expansion ratios is not dependent on the nature of the fuel.

Aluminum Alloy Pistons

► ALTHOUGH SOME manufacturers are sticking to cast iron pistons in gasoline and other internal combustion engines, most now believe the aluminum alloy piston to be better, the Society of Automotive Engineers was told by Charles E. Stevens, Jr. Bimetallic Corporation, Chicago.

Cast iron makes good pistons, he said. They are tough enough, strong enough and wear resistant enough to do a good job. Aluminum alloy pistons, however, have several advantages. Most important are their light weight and their high thermal conductivity.

An internal engine piston reverses its direction of motion twice each revolution of the crankshaft. A light piston can be responsible for increased acceleration, decreased bearing loads and decreased vibration.

Of almost equivalent importance is the higher coefficient of thermal conductivity of the aluminum over cast iron. High piston head temperatures are conducted rapidly to the ring grooves and hence to the cooled cylinder wall. Lower head temperatures mean less detonation and less tendency toward pre-ignition.

Use of high-compression engines in automobiles to replace the present power plants requires proper motor fuels. A report on studies made to evaluate fuels for such engines was presented by M. M. Roensch and J. C. Hughes of the Ethyl Corporation Research Laboratories.

A General Motors Research high-compression test engine was used. Also used were a series of cylinder heads permitting changes in compression ratio from six-to-one to twelve-to-one. The results show that power and specific fuel consumption are improved as the compression ratio is increased. They show also that thermal efficiency is increased for each compression ratio increase of one.

Airport Problems

► THE HOT BLASTS from the exhausts of jet airplanes present problems in the design and management of commercial airports suitable for the jet liners of the future.

These problems were discussed recently by D. W. Rentzel, head of the U.S. Civil Aeronautics Administration at a Conference on Ground Facilities of Air Transportation at the Massachusetts Institute of Technology. Hot blasts from jets may have a temperature of 1,000 degrees Fahrenheit at a distance of 10 feet from the exhaust.

On military air fields damage from the hot blast on airport landing strips has resulted in softening and erosion

of bituminous surfaces, erosion of soil and turf near the pavement edge and deterioration of joint seal compounds in concrete pavements. Up to now, Mr. Rentzel said, no satisfactory way has been found to overcome these difficulties.

The operation of jets on the ramp at gate positions is another problem to be solved for jet aircraft. An economical means of taxiing aircraft to and from gate positions must be found to eliminate the danger of fire to other aircraft parked on the ramps, to persons in the vicinity and to structures.

The length of runways is an important consideration if they are to be used by jet liners. Present airports in what is called the Intercontinental, or Intercontinental express, category can look forward to jet aircraft in the near future. Their present runways, being 7,000 and 8,400 feet respectively, are satisfactory.

Runway length can be met by further studies in the aerodynamic design of jet aircraft, Mr. Rentzel declared. However, in order to take advantage of the favorable characteristics of the jet engine, a compromise may be necessary in aircraft design in order to utilize present airport size standards. Before jet engines come into use in civilian planes, turbo-prop engines may become common. No radical changes in airport design are necessary for turbo-prop powered planes.

A 75-year-old limestone mine, with some 12,000,000 cubic feet of space, near Atchison, Kans., is proposed for the cold storage of government lard, eggs and other perishables; some refrigeration equipment will be required.

Aluminum arsenate, produced in Brazil and used locally, is claimed to be as effective in controlling cotton leaf worms as the lead arsenate long used.

Outstanding Chemical Patents

Copies of patents may be ordered by number from the U.S. Commissioner of Patents, Washington 25, D.C. Remit 25 cents for each patent, in coin, postal money order or Patent Office coupon (but not stamps).

New Stainless Steel

► A "WORKABLE" stainless steel, which can be shaped and fabricated in a relatively soft condition and then hardened by heat treatment, brought George N. Goller, Baltimore, Md., patent 2,506,558.

The invention provides an especial quality of chromium-nickel stainless steel through close correlation of amounts of chromium and nickel, with critical amounts of aluminum and carbon. The process is a simple, practical and reliable method of obtaining a workable steel which may be safely machined, punched, stamped, spun, bent and drawn. It may then be brought to a hardened state by heat exchange treatment at temperatures sufficiently low to avoid warping and the formation of heat scale.

Other stainless steels, the inventor states, do not appreciably respond to hardening by heat treatment. They do obtain hardness by cold working but, in actual practice, there are sharp limitations upon the possible use of this method to achieve desired hardness. Patent rights have been assigned to Armco Steel Corporation, Middletown, Ohio.

New Ice Melts Slowly

► SLOW-MELTING ice, designed to better the chances of fruits and vegetables reaching market fresh and not-over-ripe, is the invention of Jagan N. Sharma of Los Angeles, who received patent 2,509,579.

He found that a tiny amount of an organic compound such as fluorescein, added to ordinary tap water, changes the characteristics of both solid and crushed ice. The treated ice lasts 7% to 16% longer, is tougher and not so brittle. Cantaloupes shipped from California to New York or Philadelphia in the new ice did not need re-icing on the way. Ordinarily, re-icing would have been necessary three to four times.

Protects Atom Workers

► AN INSTRUMENT which can measure the radioactivity of the entire surface of the human hand was patented by John A. Simpson, Jr., of Chicago (patent 2,509,700) and assigned to the U.S. Atomic Energy Commission. It is designed to protect workers in atomic energy plants from unknowingly carrying home radioactive particles from dust or dirt picked up at work.

For Radioactive Materials

► RADIOACTIVE materials will present no danger to handlers and others while enroute from U.S. Atomic Energy laboratories to research institutions if shipped in a recently patented carrier.

Such carriers must be made of lead or other suitable shielding material. In this carrier the lead is encased in steel to give added strength. Its particular feature is the design which permits holding a number of radioactive slugs.

The inner part is a cylinder that can be revolved. In the cylinder are bores to hold the slugs. Each bore can be rotated under a single opening. This assures ease and safety in loading and unloading.

Patent 2,514,909 was awarded to Gerald Strickland, Medford, N.Y., for this carrier. Rights are assigned to the U.S. Atomic Energy Commission.

Tinning Copper Wire

► PROTECTING copper wire against corrosion with a coating of tin is a well-established practice. Soldering is aided by the tin coating, and rubber insulation on the wire is more easily removed from tin-coated wire than from uncoated wire. A new process is concerned with an effective coating containing some tin but cheaper than a coating of the pure metal.

The coating material is a lead-base alloy containing tin, cadmium and antimony. It has 10% or less of tin, 1.5% or less of cadmium and less than one per cent of antimony.

Patent 2,515,022 was issued to Clermont J. Snyder and Willis G. MacLelland, Hastings on Hudson, N.Y., with rights assigned to Anaconda Wire and Cable Company, New York City.

Latent Heat Clothing

► THE LATENT heat of a chemical is used to keep the body warm in special clothing for use in extreme cold

weather. The chemical picks up heat from the body and air before the cold is encountered and gives it off when low temperature cools it.

This body-warming clothing is made of sponge rubber containing in its pores an inorganic salt which has a melting point in the neighborhood of normal body temperatures. Body temperature tends to melt the salt. In melting it absorbs heat, so-called latent heat, which changes the chemical from a solid to a liquid but causes no increase in its temperature. Some call it heat of fusion.

There are several inorganic salts that melt at near the temperature of the body. The preferred chemical for this purpose, according to this clothing inventor, is hydrogen disodium orthophosphate dodecahydrate. It will harm neither the human body nor the rubber.

Patent 2,515,298 was awarded John E. Feldman, Garfield, N. J., for this invention. Patent rights have been assigned to the United States Rubber Company, New York City.

Cr-Mo Coating For Metals

► PROTECTIVE coatings of chromium-molybdenum alloys on iron, copper and other metals to eliminate rusting and other corrosion are applied by a simple electroplating method.

The dense, close-sticking coating of these alloys gives high resistance to oxidation and the corrosive action of chemicals. In addition, the process makes it possible to apply both metals easily at the same time. Irregular surfaces can be completely covered.

The electrolyte used in the process is made by dissolving chromic oxide in from six to seven times its weight

of water, dissolving molybdenum trioxide in this solution and adding a little sulfuric acid. This bath, at a temperature of about 100 degrees Fahrenheit, is then ready for use by ordinary electroplating procedures.

Patent 2,516,227 was issued to Chuk Ching Ma, Orange, N. J., Patent rights have been assigned to Westinghouse Electric Corporation, East Pittsburgh, Pa.

Ethyl Chloride Process

► AN IMPROVED and continuous process for making ethyl chloride, a chemical now widely used in industry as a solvent for oils, resins and waxes, brought John Lloyd McCurdy, Midland, Mich., patent 2,516,638 with rights assigned to the Dow Chemical Company of the same city. His process, like others, makes the chloride from ethyl alcohol.

In his method, the concentration of water in the reaction chamber is not materially increased, as in other methods, and the quantity of alcohol is not materially diminished by the reaction process. Water formed as a by-product in older processes accumulates in the

reactor and prevents action because of the dilution. With no water to remove, he claims his process is continuous and also economical.

Fuel Gas From Fine Coal

► FUEL GAS from finely divided anthracite, bituminous and sub-bituminous coal, also from lignite, peat or coke, is obtained in an improved process which earned patent 2,516,141 for Louis L. Newman of Washington, D.C., and Jack T. Donovan of Louisiana, Mo. Rights are assigned to the U.S. Department of the Interior.

One of the major features of this gasifier is a series of nozzles for jetting the material with oxygen into the reaction zone of a vertical chamber. The jets are so placed that a violent turbulence is produced and the gases and the finely divided coal are well mixed. Another feature is a series of jets for introducing superheated steam and carbon dioxide at points lower down in the walls of the chamber than the inlets for the coal-oxygen mixture. The result is gas of high heating value from fine coal dust much of which is now wasted.

DFDT Deadlier to Flies Than DDT

► AN APPLE-SCENTED German cousin of DDT, known as DFDT, proves to be a better killer of houseflies and certain other flying insects than DDT. At the same time DFDT is apparently less toxic to warm-blooded animals and fish, Dr. W. T. Sumerford of the U.S. Public Health Service told members of the American Chemical Society at a regional meeting in Shreveport, La., recently.

The "F" in DFDT stands for

fluorine, two atoms of which are substituted for chlorine atoms in the original DDT formula. Spelled out in full, the compound is di-fluoro-diphenyl-trichloro-ethane. It was much used in Germany during the war, but is only now being investigated in this country. Although it kills fewer insect species than DDT, it has quicker knockdown power against the ones it does affect.

Unusual Use For Silicone Films

Coatings For Medicines

U.S. Patent No. 2,512, 192, SILICONE RESIN MEDICAMENT COATING, Ernest C. Yen and Frank E. Stirn, Pearl River, N.Y. assignors to American Cyanamid Company, New York, N.Y.

► OUR invention relates to a coating, and a method for coating such medicaments as capsules, pills and tablets whereby these medicaments are protected from moisture and/or oxygen or other substances with which they come in contact which tend to cause variations in their medicinal value, and at the same time, the escape of materials in said medicaments is prevented. In the past there has been a considerable field for development in the production of soft gelatin capsules containing various substances. Certain of these substances, particularly thiamin, vitamin A, vitamin D, vitamin E and liver concentrates, have an odor which escapes through the walls of the gelatin capsule and is not particularly desirable. At the same time oxygen from the air and moisture can penetrate the gelatin shell causing a gradual decrease in potency of the contents of the gelatin capsules. When these gelatin capsules are filled with dry powders certain of the powders tend to react with each other or the gelatin of the shell in the presence of moisture causing black spots, thus giving rise to a product which meets consumer resistance.

In the past certain enteric coatings have been used such as shellac or gum

sandarac, etc., for the purpose of protecting capsule contents from the acid of the stomach, and which disintegrate under the conditions of the intestines. In contrast thereto we have found that by using our superior type of coating it is possible to coat a gelatin capsule or nearly any of the normal commercial tablets or pills with a thin coating of a silicone resin whereby these objects are re-enforced mechanically, resist abrasion, possess a clean, polished, pleasing appearance, are more resistant to moisture, oxygen and other deleterious substances, and at the same time retain their potency longer.

As an object of our invention there is provided a coating for tablets or shells which gives a comparatively high gloss, smooth finish and non-dusting film, which meets with ready consumer acceptance, insures the constancy of the dose, and markedly decreases the number of broken, nicked and defective tablets. Tablets which are sold in drug stores in bottles, such as some grades of aspirin, cough tablets, bicarbonate of soda pills, anti-acid pills and many others, have a tendency to dust by frictional contact whereby portions of the exterior surface are broken away. This gives a nicked appearance to the tablet, cuts down on the volume of the tablet so that the dosage is no longer uniform, and leaves a dust or powder in the container which is aesthetically unde-

sirable and meets with consumer resistance. Our protective coating reinforces the surface layers of the tablets so that this dusting, crazing, cracking and surface disintegration is prevented, the tablets maintain a uniform size of dose, are more pleasing aesthetically and are but slightly if any, slower in decomposing; so that the tablets will not disintegrate in the bottle but yet will disintegrate without an appreciable change in time in the mouth or stomach, releasing the therapeutic dosage.

Another object of our invention is the protection of soft gelatin capsules where, by coating the gelatin film either internally or externally or both, during the process of manufacture or afterwards, a gelatin shell capsule is produced containing a therapeutic substance, which substance is given greater protection because of this coating, and which gelatin shell is itself protected from the deteriorating influences of materials both within the capsule and externally. As remarkable as it may seem it has been found that by filling a soft gelatin capsule, which gelatin shell itself contains considerable moisture, with a moisture sensitive substance such as vitamin C, the vitamin C will cause the gelatin shell to show dark spots; but if the gelatin capsule is dried and coated with a silicon film in accordance with this, our invention, the same capsules will maintain a clear, unspotted appearance, even in the presence of high humidity for a prolonged period of time. It is not known how long the contents will thus be protected by the silicon film but extensive tests have been carried out over a period of many

months under accelerated aging conditions without any breakdown in quality. It is expected from such tests that such coated capsules would last without deterioration under average conditions for a period of at least several years, and probably indefinitely.

A further object of our invention is the treating of hard gelatin capsules by coating with a silicon resin whereby the two parts of the gelatin shell are adhesively fastened to each other so that these capsules will stand up under shipping conditions without parting, or the releasing of dust, for prolonged periods. Additionally, the gelatin capsule is protected from the deleterious effects of moisture, atmospheric gases, and other disintegrating agents with which the capsule may come in contact.

Surprisingly, these films while apparently resistant to moisture will not appreciably delay the absorption of the therapeutic materials once ingested, and do not leave a residue which is either appreciable or in any way deleterious.

The coating of our new invention comprises a silicon containing resin. It is necessary that the silicon resin be in a form which may be applied as a thin film, which will polymerize, or set to the desired state. For some purposes a sticky or tacky film is useful but normally for greatest commercial acceptance it is desirable that the film form a fairly hard, dry, lustrous, non-tacky, smooth surface. From the standpoint of commercial utility for most pharmaceutical products it is necessary that the film cure to this state without the application of much heat. The amount of heat that can be used,

of course, varies with the material in the capsule, pill or tablet but for many pharmaceutical products, 60° C. is about the limit. Any of the silicon containing resins which are cured under these conditions and which may be applied in thin layers appear to be satisfactory.

The particular silicon resins themselves are not a part of this invention and any of the standard commercial resins may be used. It is not necessary that the material be applied as a liquid, as some of these silicon resin forming materials, such as the General Electric "Drifilms," are volatile and may be applied in the gaseous phase. These materials are among the volatile silicon compounds such as alkyl silicon halides. A material such as dimethyl silicon dichloride is comparatively volatile and may be applied to a gelatin film either direct or by allowing an ethereal solution thereof to evaporate and the vapors contact the gelatin film or tablet.

Frequently, however, it is more convenient to use a liquid preparation. Such preparations are solvent dispersions of "silicone resins," that is partially polymerized products which will polymerize to a silicone resin. For purposes of convenience it is normally easier to purchase the material under trade-names rather than making it, or obtain it to a performance specification. Materials which are sold commercially such as the Dow-Corning silicone "DC 803" or "DC 804" or General Electric's "9980" give highly satisfactory and useful films. To those skilled in the art of silicone compounding it is comparatively simple to select a heat-curable or

potentially heat-curable silicone resin, which either from its inherent characteristics, or the addition of a polymerizing agent, will set up or cure without the use of sufficient heat to deleteriously affect the medicinal substance. As a final check to insure the complete removal of all halide to silicon linkages, ammonia fumes may be used. Usually sufficient moisture is present to insure the hydrolysis of the halogen, but ammonia fumes insure a neutral product. If desired silicon containing resins may be used in which the silicon atoms are linked through nitrogen, from ammonia, rather than through oxygen as in the silicones, such resins at times being referred to as silamines.

There are many discussions of methods for preparation of silicon resins. Patent No. 2,306,222 to W. I. Patnode "Method of Rendering Materials Water Repellent," discloses the use of a vapor of an alkyl silicon halide for making glass vapor-proof. The same types of materials as therein described may be used to water-proof, protect and render odorless medicinal compounds. The patent to Safford, No. 2,424,853 and the patent to Tanis, No. 2,408,822, additionally describe siliceous halides and their conversion to resins. There are several methods of preparing such silicon resins, among the others are the reaction of Grignard type reagents with a silicon tetrahalide. From the standpoint of costs silicon tetrachloride is normally used and the Grignard may be either alkyl or aryl or a mixture thereof. The amounts of each alkyl and aryl used affect the brittleness and rate of cure of the resin formed. Normally the

product of the reaction of the Grignard reagent with silicon tetrachloride is allowed to react with moisture, allowed to partially polymerize and the partially polymerized materials are dissolved in a suitable solvent whereby additional polymerization is either inhibited or substantially slowed down. The higher the ratio of lower alkyls, the more rapidly the materials will cure and the more brittle will be the film. The more highly branched the chains formed in the resin, which are necessarily formed by the polymerization of the silicone types containing more halide atoms per silicon molecule, the more brittle and polymerized are the resins.

The organo-silicones sometimes referred to as organo-polysiloxanes, more particularly the hydrocarbon substituted polysiloxanes, are particularly suitable for coating. The patent to Wright et al., No. 2,389,477, entitled "Polysiloxane Resins" gives considerable information of this type of resin. Certain of the resins which are described in the patent to Hyde, No. 2,386,466, "Insulated Conductor and Insulation Therefor," which is diluted with a solvent may be used in accordance with the instant invention. The patent to Hyde, No. 2,371,050, "Organo-Silicon Polymers and Method of Making Them," describes certain additional methods of preparing such resins. It is not necessary that the resins be prepared from halogen containing compounds as for example, methods such as set forth by Strain et al. in Patent No. 2,394,642, "Silicic Acid Ester," describes a different form of silicon containing resin. The patent to Iler, No. 2,395,550, "Modified Alkyl Resins," describes still further

modifications of silicon containing resins in which the silicon linkages are different than those classified as organo-polysiloxanes.

The text "Introduction to the Chemistry of the Silicones," Eugene G. Rochow, John Wiley & Sons, Inc., New York, 1946, gives many useful details on the production of such resins.

The therapeutic material to be treated with these resins may be treated in the gaseous phase by allowing vapors to contact the materials but are more conveniently prepared by dissolving the silicon resins in solvents such as toluene, isopropyl alcohol, petroleum ether or acetone to the extent of 1% to 10%. The tablets or capsules are then submerged in this solution for a period at least sufficient to allow them to become wetted, and perhaps for periods as long as several minutes, removed from the solution, shaken to remove excess liquid and allowed to dry. A convenient method of drying is to place the coated capsules or tablets on a screen; a screen made up of fine parallel bars with the narrowed edges presented to the capsules is particularly valuable, as it assists in draining off the liquid and gives greater rigidity. The capsules may be agitated while drying but it is preferable that they remain at rest without touching each other. The solvent is allowed to evaporate, and the resin polymerize on the surface giving a resistant coating. With certain resins it is necessary that the capsules be heated to 50° C. for a period of four hours to sufficiently polymerize the material so that it is tack free. Others will polymerize within reasonable

time at room temperature. Setting of the silicon containing resin may be expedited by the use of small quantities of a drier such as metallic naphthenates, or others known to the trade. Cobalt naphthenate to the extent of 0.3% by weight of that of the solids in the resin will markedly reduce the drying time of the silicone resins.

Some imperfections will appear in the coating where the capsules contacted each other or where they were supported by the screen during the drying operations, but such imperfections are slight and do not interfere with the salability of the product. It is desirable though, that the number of such contacts be kept at a minimum.

If it is desired to color the capsules, the silicon containing resin coating may be colored with either dyes or pigments. The use of pigments will conceal any imperfections in the capsule itself, and give a remarkably smooth coating. However, by the same token the pigment coating must be perfect to avoid showing defects in such coating. Two or more pigmented coatings may be used to partially allow for contact points being uncoated in each. Recommended practice, however, is to use a comparatively transparent resin coating thus showing any

ornamentation in the original capsule and at the same time the contact points will not show except on the most critical inspection.

The silicone resin coating may additionally contain flavors and preservatives. Any of the standard flavors which it is desired to introduce into the capsules to flavor and/or perfume them may be mixed with a compatible solvent, as may the preservatives. Under unusual conditions the gelatin, or contents of a capsule or tablet, may be attacked by various organisms. By the introduction of a preservative such as methyl-p-hydroxy-benzoate, propyl-p-hydroxy-benzoate or other acceptable preservatives, the shelf-life under adverse conditions may be prolonged. The preservative is concentrated in the external surfaces where disintegration might otherwise begin. Flavors and odors such as methyl salicylate or coumarin may be introduced as may any other suitable flavor, the choice is strictly one of aesthetic appeal. By concentrating the flavor on the outside of the capsule a smaller quantity of flavor can be used to give the desired aroma, and the main portion of the medicinal substance will not have such flavor, color, odor or preservative necessarily admixed therewith.

Arkansas Bauxite Contains Titanium

► ARKANSAS bauxite ore, now being used as a source of alumina, contains valuable titanium and iron minerals, recoverable by a process developed by the U.S. Bureau of Mines. Recovery of these by-products will promote the use of domestic bauxite. Methods of

recovery of these present wastes are given in a report from the Bureau's publication section at Pittsburgh, Pa.: "Titanium and Iron Minerals from Black Sands in Bauxite," by W. A. Calhoun, Bureau metallurgist, Bauxite, Ark.

Proudly Presented

- A LARGE CHART outlining the history of chemistry is being distributed by the Mallinckrodt Chemical Works, St. Louis 7, Mo., to schools, libraries and institutions and also to individual chemists.
- STABILIZERS and lubricants for polyvinyl chloride plastics, in the form of lead stearates, are offered in a technical service report by Witco. Two products, #50 with 50% metal content, and #30 with 30%, are available. Lubricating properties are more pronounced in the #30, while #50 excels for heat stabilizing.
- FORMALDEHYDE in solution in a variety of alcohols is offered under the trade-name Formcel by the Celanese Corporation's Chemical Division. It is made at their Petroleum and Research Laboratory at Clarkwood, Texas. More information and a working sample can be had from the company at 180 Madison Ave., New York 16, N. Y.
- A BOOKLET "Fundamentals of Steel Casting Design" by Charles W. Briggs, in a new revised edition, is available from the Steel Founders' Society of America, 920 Midland Bldg., Cleveland 15, O.
- NEW SILANE compounds available from pilot-plant production by Linde include Vinyltrichlorosilane in 1, 5, and 10 lb. containers; Diethyldichlorosilane, 1, 4, and 8 lb.; and Phenyltrichlorosilane in 1, 5, and 11 lb. lots. The chlorine atoms are all replaceable, allowing a variety of polymers whose composition and properties can be controlled at will. Further information and prices may be obtained from the New Products Division of the Linde Air Products Co., 30 East 42nd St., New York 17, N. Y.
- STEP-BY-STEP photographs illustrate the new Croning process for producing molds and cores with Bakelite phenolic resins in a booklet published by the Bakelite Division of Union Carbide and Carbon Corp., 300 Madison Ave., New York 17, N.Y.
- TITANIUM DIOXIDE for enamels and lacquers is being manufactured and distributed by the American Cyanamid Co. Two kinds are available, coded as Unitane OR-342 and O-310. The latter is known as the Anatase type and is especially recommended where high opacity is not essential. OR-342 is the Rutile type and designed for use in alkyd baking enamels. Samples of both are available for testing purposes upon request to the American Cyanamid Co., Calco Chemical Division, Bound Brook, N. J.
- A NEW HYDRAULIC fluid for die casting machines, hydroelectric turbines, glass drawing machines and the like, which has exceptionally good fire-resistant qualities is offered by Monsanto under the designation F-9. In Technical Bulletin No. O-D-602 the manufacturers list the data necessary to users, and suggest that those interested write the Development Department, Monsanto Chemical Co., Organic Chemicals Division, 1700 S. Second St., St. Louis 4, Mo.

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